

# URBANIZATION AND MALE CLIENTS OF SEX WORKERS IN THE UNITED STATES

by  
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## Dissertation Abstract

Background: Male clients of sex workers' risks to sexually transmitted infections (STI) and HIV, and whether their prevalence differs by urbanization in the United States are poorly understood. The goals of this dissertation were to examine clients' sexual risks, substance use, history of STIs and HIV testing, and to examine their prevalence by urbanization level nationwide, and by population changes and population growth within U.S. metropolitan areas.

Methods: Survey data was derived from a national random sample of English speaking adults conducted in 1999-2000. STI/HIV correlates of clients, and whether their prevalence differs by urbanization level in the U.S. was examined among 469 men linked to the National Center for Health Statistics Urban Rural Classification Scheme for Counties. County population changes were derived from the 1990 and 2000 U.S. censuses. Population relative change was examined with male clients in a sample of 385 metropolitan men. Prevalence ratios were estimated using Poisson regression for survey data. Generalized estimated equation regression was used to examine the association between whether a county increased population at a slower, similar or faster rate than its metropolitan region with male clients among 303 men.

Results: The overall prevalence of male clients was 14.5 (95% confidence interval, 11.5-18.1). Clients of sex workers in the U.S. have an elevated history of STIs and associated sexual risks. They were similarly distributed across urbanization level. However, we consistently found that the speed of urbanization in counties that are already part of established metropolitan areas was positively associated with the prevalence of clients.

Conclusions: U.S. male clients represent an important high-risk group for STI/HIV. The findings support the notion that population changes may be a resourceful geographical indicator to address STI/HIV risk from transactional sex. Clients merit further public health research to help guide comprehensive prevention measures targeting their elevated risks to infection and their role in the current HIV epidemic.

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## **Chapter 1: Introduction**

### **Urbanization and Male Clients of Sex Workers in the United States**



## **Background**

Urbanization unevenly transforms the landscape, impacts social conditions and may influence the risks to infectious diseases.<sup>1,2</sup> Men who buy sex from sex workers (henceforth referred to as “clients”) are at an increased risk of acquiring and transmitting sexually transmitted infections (STIs) and HIV.<sup>3-5</sup> There is, however, a paucity of research on the relationship between urbanization and key high-risk groups for STI/HIV, and on clients of sex workers in general. The main objective of this study was to examine the relationship between urbanization and clients of sex workers in the general population of men in the United States.

### *Estimates of Male Clients of Sex workers: Internationally and in the United States*

A comparison of the prevalence of heterosexual male clients of sex workers from 78 available national household surveys, mainly the Demographic and Health Survey (DHS), administered from 1989 to 2004s in 54 countries in various regions revealed that 1% to 14% (with a median of 9-10%) of men in the general population reported to have paid for sex in the past year.<sup>6</sup>

Reports derived from probability surveys of the general population with available estimates for both lifetime and past year prevalence for men buying sex suggest that a small percent of men has bought sex in the past year, but it is not uncommon to occur at some point in their lifetime.<sup>7-9</sup> In Spain, one-quarter of men aged 18 to 49 years old reported to have paid for sex in their lifetime while only 5.7% of men reported to have paid for sex in the past year.<sup>9</sup> A considerably lower estimate for lifetime (8.8%) and past year (1.3%) prevalence for buying sex was reported among 16 to 49 years old British men.<sup>8</sup> Findings from the 1988 to 1998 General Social Surveys (GSS) indicate that an estimated 0.7% of U.S. men aged 18 and older had paid for sex in the past year and 14.2% had done so in their lifetime.<sup>7</sup>

### *Variations in Estimating Male Clients of Sex Workers*

Derived from common definitions for a sex worker,<sup>3,10</sup> a client of a sex worker is a person who provides someone immediate cash or its equivalent in return for sexual services. This exchange may be between persons of any gender and age. Differences in the measurement and in the reporting of male clients are widespread in epidemiological studies, thus the compatibility of findings across studies is often times overgeneralized. In the previously mentioned multi-national comparison estimating the prevalence of clients<sup>6</sup>, a substantial variation in the prevalence of male clients was observed from slight variants in the

question wording in the DHS conducted in the same countries about five years apart. Surveys conducted in Eastern African countries had a 1.5% median past year prevalence of male clients in the years that the survey asked about paying for sex or having sex with a sex worker compared to a median 9.8% past year prevalence when the question specified paying someone for sex with gifts, favors, or money. Similar differences in the prevalence of male clients were reported for other African regions with available data highlighting that the extended definitions may obscure the context of HIV-risk linked to sex work from more widespread practices of transactional relationships which have different implications for prevention services.<sup>11, 12</sup> For example, one of the implications with the extended definition is that women receiving gifts and favors may not perceive themselves or are regarded by their provider sex partner as sex workers, and unlike the subpopulation of female sex workers, may not be typically stigmatized and criminalized.<sup>10</sup>

A national representative study of the general population in China defined clients as men who provided valuable gifts for sex, men whose long-term partner was a sex worker, and those who identified a short-term partner as a sex worker.<sup>13</sup> While this broad definition to approximate sexual contact with a sex worker likely raises the estimate for men who have paid for sex, it may also mask potential differences in the risk of STIs and HIV by type of relationship. More restrictive variants for defining male clients were observed in other country-specific nationally representative studies of the general population. These studies defined clients according to the following phrasing: Australia: “ever paid anyone to have sex with you including oral sex and manual stimulation”<sup>14</sup>; Britain and Spain: “ever paid money for sex with a woman”<sup>8, 9</sup>; and in India derived from responses to items that asked whether at least one of the last three sexual contacts was a sex worker, and had paid for sex in the past year.<sup>15</sup> National estimates for adult men in the United States derived from the GSS were reported as “sex with a prostitute” although survey questions do not differentiate between paying for sex and being paid for sex.<sup>7, 16</sup> Reported findings correspond to heterosexual paid sex in Britain and Spain, but findings from Australia, India and the United States are of unspecified sexual orientation.

The use of the description “money or drugs” as a form payment for sex in measures of paid sexual relationships was observed to be more common to studies conducted in the U.S.,<sup>17, 18</sup> and have also extended to include “a place to stay,”<sup>19</sup> and “something else.”<sup>20</sup> Reports derived from the National HIV Behavioral Surveillance of high-risk heterosexual adults provide infection and behavioral correlates of

exchange relationships (i.e. buying and selling sex combined),<sup>21,22</sup> and findings specific to those who bought sex include women even though buying sex was infrequently reported by women.<sup>17</sup>

Attention to the role of male clients of sex workers in STIs including HIV appears to be emerging in the health literature. However, there is a need for future research to clearly delineate buying sex from someone who sells sex as a form of income generating to reduce potential inclusion of sexual partners who receive assets as part of their relationship but may not be subjected to the higher infection risks of sex work. A better understanding of the role of exchanging other resources and sexual risk is, however, also warranted. Furthermore, to inform prevention of STIs, a better understanding for the proportion of types of unprotected sexual acts purchased are needed. In the interim, the limited available literature on male clients is presented in view of the complexity in the compatibility of findings across studies and in contextual factors that may differ in various settings.

#### *Estimates of Male Clients in Urban and Rural Environments: Internationally and in the United States*

Reports with national estimates of male clients generally include comparisons by the current urbanization level in the area of residence. Overall findings suggest that the concentration of male clients in urban areas may be country-specific. A significantly higher prevalence of paid sex was reported by men residing in the most urbanized city or an urban area compared to less urbanized or rural areas in Britain,<sup>8</sup> China<sup>13,23</sup> and India.<sup>15</sup> In Britain, the prevalence of having bought sex in the past five years was 8.6% (95% confidence interval, 7-11%) in London, compared to 3.7% (95% CI 2-6%) in other urban municipalities, 3.0 (95% CI 2-4%) in suburban residential areas, and 4.1% (95% CI 3-6%) in town or villages.<sup>8</sup> The prevalence of ever male clients, but not the prevalence of past year male clients, was found to differ by urbanization level (i.e. major city, regional, and remote) in Australia.<sup>14</sup> Furthermore, minimal differences in the prevalence of male clients in the past year were found by urban and rural residence in two-thirds of the 49 countries examined by Careal *et al.*<sup>6</sup> using DHS and other national surveys. Pan *et al.*<sup>23</sup> also analyzed DHS studies in 42 countries from different regions with a median survey year of 2003, and reported that the median (and inter-quartile range) prevalence of past year male clients among 15 to 49 years old was 2.6% (0.8-4.0) in urban areas and 1.7% (0.6-3.9) in rural areas. Compatibility in the classification of urban and rural areas between countries was however not described in the reports of multi-nation analyses.

In the U.S., estimates derived from the General Social Survey for men aged 18 and older indicate that there is a higher prevalence of ever male clients residing in the top 100 metropolitan areas (18.4% to 20%) compare to those residing in the remaining metropolitan areas and non-metropolitan areas (13.7% and 12.6%, respectively).<sup>7</sup> Also derived from the GSS, the prevalence of paid sex in the past year was 2% in the central cities of the top 12 metropolitan areas and less than one percent (0.3% to 0.7%) for remaining areas. The population size corresponding to the ranking of metropolitan was not described. These estimates are based on results from 1988 (past year) and 1993 (ever) through 1998 combined survey years. Since the year 2000, the classification of non-metropolitan areas has been revised to separate small urban centers (micropolitan areas) and remaining less populated areas. To my knowledge, there is no published information on male clients by the rate of urbanization in any geographical area.

*STIs and HIV Prevalence and Risk Factors among Male clients: Internationally*

Although sexually transmitted infections (STIs) and HIV prevalence and risk factors research on men who have purchased sex from sex workers is globally limited, clients in diverse settings have been found to have an increased burden of STI/HIV.<sup>24-32</sup> In national surveys conducted in Australia, Britain and China, clients were three to ten times more likely to self-report a history of STIs than never clients or non-recent clients.<sup>8, 13, 14</sup> In addition to a ten times higher prevalence of self-reported history of STIs, the prevalence of *Neisseria gonorrhoeae* and *Chlamydia trachomatis* from urine testing were nine folds and forty-four folds higher, respectively, among male clients compared to non-clients in nationally representative sample in China.<sup>13</sup> In various settings, biomarkers for a number of STIs have been commonly detected among clients of sex workers.<sup>25-30</sup> HIV acquisition and transmission is enhanced by the presence of STIs.<sup>33, 34</sup> Based on convenience samples in studies that offered HIV testing, clients of female sex workers from countries with a low HIV prevalence (<1%) were found to have a two to eighteen folds higher prevalence of HIV than the country-specific HIV prevalence in the general population.<sup>27-31, 35</sup> In Thailand, where the prevalence of HIV exceeds 1%, frequency of visits to sex workers was positively associated with prevalent HIV infection among male conscripts.<sup>24</sup>

Clients' higher risk of STI/HIV infection may be due to the disproportionately higher levels of infection that tend to be experienced by sex workers than that of the general population in many settings,<sup>4, 36, 37</sup> and clients other behavioral risks factors that put them at increased risk of acquiring infections.<sup>8, 9, 13-15,</sup>

A high prevalence of condom use (97%) at the most recent sex with a sex worker was found among men in Australia along with a contrasting history of high-risk behaviors.<sup>14</sup> Australian men who reported to have ever bought sex were also more likely to report three times as many lifetime partners, at least twice as many sexual partners in the past year, and were 2.6 times more likely to have injected drugs than men who had never bought sex. High partner change was also found among clients than non-clients in Britain. More than a third (36.5%) of British men who had paid for sex in the past five years also reported having had at least ten sexual partners during this period compared to only 8% among men who had not bought sex.<sup>8</sup> Earlier sexual initiation was associated with history of purchasing sex in Spain and China which would increase the opportunity to accrue more lifetime partners and increase the risk of sexually acquired infections.<sup>9, 13</sup>

Findings from clients surveyed at commercial sex sites in India, Vietnam, Haiti, Guatemala, and Mexico also indicate that clients' high-risk activities are not limited to sexual contact with sex workers.<sup>26, 28-31</sup> For example, among clients reporting consistent condom use with sex workers in the Mexico site, about one-fifth of clients (18%) had injected drugs, 59% of injectors had shared needles, 54% had used methamphetamines, 54% were high and 36% were drunk during sex with a sex worker, and 12% indicated that their current steady partner or wife was a sex worker.

Other studies of the general population have reinforced clients' considerable potential for bridging infection between sexual partners.<sup>13, 15, 38</sup> For example, more than half (52%) of past year male clients in India reported inconsistent condom use with sex workers, with a higher prevalence of inconsistent condom use found among ever married male clients than never married. A similarly high prevalence of inconsistent condom use with a casual partner (75%) and spouse (97%) were found between male clients and non-clients in China (12).

#### *STIs and HIV Prevalence and Risk Factors among Male clients: United States*

To date, there are no published epidemiologic national estimates of STI or HIV prevalence for men who have purchased sex in the United States, although persons who have sold sex have been found to have an increased burden of STI and HIV.<sup>39-41</sup> A few non-probability samples from U.S. metropolitan settings have specifically examined the relationship between men's STI/HIV risks and purchasing sex.

Supporting evidence of clients' increased risks for STI/HIV in the U.S. comes from diverse special populations (i.e. among adults involved in transactional sexual relationships, drug users, men who have sex with men (MSM), international migrants, and public health clinic patients).<sup>17-20, 42-44</sup> Among residents of high-risk HIV neighborhoods in New York City that reported having had transactional sexual relationships, numerous partners (median 7) and a high prevalence of unprotected sex with both paid and non-paid partners (43%) in the past year was found for clients (majority men), though a lower prevalence compared to those who had sold sex.<sup>17</sup> A higher prevalence of syphilis (10% and 16%) and HIV (3% and 37%) infection, as well as ever crack-cocaine (23% and 35%) and injection drug use (11%), than found in the general population, was reported by clients of female and male sex workers, respectively, recruited through a newspaper ad in Atlanta.<sup>42</sup>

Reiterating clients high risks for STI/HIV found in other major cities, clients (prevalence 9%) recruited from Boston clinics were three times more likely to report having received a STI/HIV diagnosis in the past year compared to men who had not purchased sex in the past year, as well as more likely to report having had multiple partners in a short period of time and to be less inclined to use condoms.<sup>19</sup> Other reports derived from adults in settings at high risk for HIV support that unprotected sex with someone paid to have sex varies by type of sexual activity.<sup>18, 22</sup> For example, a report among drug users that compared condom usage among transactional partnerships (i.e. either sold or bought sex, or both) and inclusive of women indicated that 52% had had unprotected vaginal sex, but 33% had had unprotected anal sex with an exchange partner.<sup>18</sup>

While Bobashev *et al.*<sup>20</sup> examined social correlates of men who had purchased sex in a sample of drug users and MSM that resided in either the central city or the suburbs of metropolitan areas in North Carolina, no other report on clients was found for populations living in less urbanized areas, with the exception of reports that included buying sex as one of many STI/HIV risk factors.<sup>45, 46</sup>

#### *Role of Male Clients in Sustaining STIs and HIV in the population*

The role of clients in sustaining STIs in the population has been inferred from interventions targeting sex workers and their clients.<sup>5</sup> Within a couple of years of the Thai government condom policy program in commercial sex establishments, a substantial decline in the number of STI-related cases were observed from surveillance statistics (e.g. from 89,238 in 1991 to 38,835 in 1993).<sup>47</sup> The relative drastic

reduction in STIs in Thailand was particularly evident for infections such as syphilis and chancroid; STIs associated with high partner change, and typical of sex worker-client partnership, to maintain transmission in the population.<sup>3</sup> The reduction in STI and HIV was also associated with changes in behavioral risks. Nelson and colleagues<sup>48</sup> reported decreases in the prevalence of HIV and syphilis, as well as drastic reduction in the prevalence of men who had patronize sex workers in their lifetime and within the past year following governmental instituted regulations. These behavioral changes towards paid help, however, highlight the influence that clients have in STI/HIV transmission in the population.

Similarly in Benin, comprehensive programs that included condom promotion aimed at both sex workers and clients in red-light districts of the major cities significantly reduced gonorrhea and chlamydia infection among male clients (Cotonou between 1998 and 2005: gonorrhea, 5.4% to 2.6%, and chlamydia, 4.8% to 1.8; other cities between 2002 and 2005: gonorrhea 3.5% to 0.59%).<sup>25</sup>

Simulation studies that have incorporated concepts of the basic reproductive rate of infection and behavioral parameters such as partner change have drawn attention to clients' role in STI/HIV infection transmission. Watts et al.<sup>49</sup> examined the duration of clients and sex workers in commercial sex settings on sustaining HIV transmission. Findings from model simulations suggested that regular clients, along with men involved in organizing sex work, could sustain HIV infection among the sex worker population when sex workers have a high turnover. Ghani and Aral<sup>50</sup> explored variations in the number of clients of sex workers and whether clients visited the same or different sex workers on influencing the prevalence of gonorrhea and HSV-2 in the general population. Results suggests that clients' dissortative sexual mixing pattern between high-risk and low-risk infection prevalence partners increase infection in the general population. In contrast, infection remained highest among sex workers and lowest in the general population when clients' multiple partners included different sex workers because infection could be transmitted more efficiently among similarly, or assortative, high-risk risk partners.

#### *Socio-Demographic Correlates of Male Clients: United States*

Men who have paid for sex have been found to vary by socio-demographics characteristics. African Americans/Blacks are more likely to have bought sex than whites and other ethnic/racial groups, and men under the age of 30 are less likely to have bought sex than older men<sup>7, 51, 52</sup>. Among economically disadvantaged men, education or employment was not associated with buying sex,<sup>18, 19</sup> but in the general

population, those with some college education, followed by college graduates had the highest prevalence of having bought sex.<sup>7</sup> The relationship between marital status and the prevalence of buying sex varies by population studied. A higher prevalence of ever buying sex was found among formerly married and remarried men in the general population.<sup>7</sup> A higher prevalence of buying sex within the past year was found among currently married or cohabiters in a sample of drugs users and MSM<sup>20</sup> but a higher prevalence of buying sex was found among the never married in a sample of Latino migrant men.<sup>43</sup> Marital status was not associated with paying for sex in one study of low-income men.<sup>19</sup>

In the U.S., it is unlawful and a low-level misdemeanor or public nuisance crime in almost all States' criminal codes and statutes to hire someone for sexual intercourse.<sup>53</sup> A descriptive report sponsored by the Department of Justice indicates that local law enforcement programs that attempt to discourage sex work activity by focusing on clients have been widespread across the country since the 1960s.<sup>54</sup> For example, 828 U.S. cities and counties of varying population size were found to have implanted at least one strategy to discourage or penalize clients for buying sex, such as: reverse stings operations targeting specific venues and websites, public shaming by publicizing identities of clients via news outlets, seizing the vehicle used to solicit sex, driver's license suspension, education (i.e. john school) and community service programs for arrestees, surveillance cameras on known prostitution areas, and other public education and awareness programs. Although the levels of law enforcement activity targeting clients have varied over time and within municipality, over the course of four decades, only about a dozen cities had recorded more clients' arrests than sex workers' arrests during a single one or two-year reporting period.<sup>54</sup> In overall, relative to sex workers, clients are less likely to be arrested, and despite law enforcement shifts towards the demand-side of the sex industry as a way to address human sex trafficking and assaults,<sup>55</sup> only a small proportion of men appear to come into contact with law enforcement for buying sex.<sup>56, 57</sup>

#### Limitations of Epidemiological Studies about Male Clients: United States

Sexual practices and risk-taking or risk-avoiding behavior of male clients in the general population are important to complement findings from high-risk groups and special populations to develop more comprehensive, effective and appropriate prevention measures for STIs and HIV. However, the existing few studies that have examined the relationship between behavioral risks of male clients are not appropriate



to infer to the general U.S population. Populations selected from high-risk settings in select central cities are by default exclusory of the majority of the population in the country. Except for studies focusing on Latino migrants,<sup>43, 44, 46</sup> other studies reporting on clients' behavioral or infection correlates in the U.S. have had a marked overrepresentation of African Americans/Blacks to that found in the general population,<sup>17-20, 42</sup> as African Americans/Blacks are more likely to attend public clinics, and reside in inner city areas characterized by a high burden of adverse social outcomes that may foster conditions for high-HIV risk activity.

Urbanization has been speculated to be a structural-level determinant of STIs and HIV by shifting sexual and drug use patterns.<sup>58, 59</sup> However, there is limited literature on the relationship between urbanization level or the process of urbanization and the prevalence of men who purchase sex from sex workers.

#### Measurement of Urbanization in the United States

Urbanization is defined as the “increase in the proportion of the population living in urban areas, or the process of people moving to cities or other densely settled areas.”<sup>60</sup> (p. 41) In the United States, urbanization level during a particular period is characterized using metropolitan status which encompasses population size, density and the economic integration of a geographic area. Metropolitan status provides the base by which urbanization level is generally described and subsequently further allocated into subareas that vary along a continuum from most urban to most rural.<sup>61-65</sup>

The Office of Management and Budget (OMB) is responsible for defining the metropolitan status of geographic areas based on Census Bureau population data.<sup>66, 67</sup> According to the OMB, a metropolitan statistical area (MSA) is defined as a geographic area that has a population of at least 50,000 with an overall population density of least 1,000 people per square mile in a place within a county or counties, and adjacent counties that collectively share a degree of economic integration. The term county is used for brevity but it includes county equivalents such as parishes in Louisiana, independent cities in Maryland, Missouri, Nevada, and Virginia, and boroughs or census areas in Alaska. The central county or counties of a metropolitan area have the largest share of the densely settled population. Outlying counties to the central county within the MSA are referred to as suburban or fringe areas. Economic integration of contiguous counties is based on the level of work commuting patterns among residents in the central and

suburban counties. More specifically, economic integration is defined as at least twenty-five percent of employed residents in a county commute to work to a different county within the MSA. New England is the only region for which the geographical boundary of metropolitan areas can also be defined using that of cities and towns.<sup>66, 67</sup>

Non-metropolitan areas consist of all remaining counties that do not meet the criteria for inclusion into a MSA. In 2003, the OMB began to identify two types of non-metropolitan counties based on the presence of a smaller densely populated area relative to criterion used for defining MSAs.<sup>66</sup> Non-metropolitan counties with a densely populated area of at least 10,000 people but less than 50,000, and any adjoining county to this core where residents share a high level of work commuting interchange were identified as Micropolitan Statistical Areas (MCSA). All remaining non-metropolitan counties unassigned to a MCSA are formally decreed non-core based statistical areas (non-CBSA).

Metropolitan status is independent of the terms “urban” and “rural” as defined by the U.S. Census Bureau as these differ to metropolitan status in the geographic unit and associated characteristics used to define them. As described, metropolitan status is based on the size and density of a population nucleus associated with a county and a commuting exchange among adjoining counties. In contrast, urban as defined by the Census Bureau, is exclusively determined on a population density threshold of census blocks, while all residual territory, populated or unpopulated, is considered to be rural.<sup>68</sup> Therefore, metropolitan and non-metropolitan areas can each have both rural and urban areas.

#### Urbanization Trends in the United States

The majority of the U.S population resides in core-based statistical areas. By the year 2000, roughly 80% of the U.S. population resided in metropolitan areas.<sup>61, 69</sup> Table 1.1 shows the 2000 U.S. population and the number of counties by urbanization level. In 2000, the total non-institutionalized U.S. population was 281.4 million, and it was distributed in 3,141 counties. A half (50%) of the total U.S. population resided in only 313 counties comprising the metropolitan areas of one million or more people. Thirty-percent of the population resided in MSAs with less than one million people and were distributed over 525 counties. Nine-percent of the population resided in the 483 Micropolitan counties. Eleven percent of the populated resided in the 1,820 counties classified as non-core based statistical areas.

There has been a steady growth of population residing in areas defined as metropolitan over the past decades. While at the turn of the twentieth century (1910), less than a third (28%) of the population resided in areas classified as metropolitan at the time of each Census, more than half (56%) was living in metropolitan areas by 1950s.<sup>70</sup> The growth of the population living in metropolitan areas is largely occurring in the suburban counties. The growth of suburban population has been attributed to annexation of non-metropolitan population and territory into existing metropolitan areas, and migration patterns associated with the growth of economic opportunities and infrastructure developments in suburban counties.<sup>71</sup> Although the majority of the migration into the suburbs has been domestic, a notable shift in international migration to the suburbs, instead of central cities, has also been observed since the 1990s as a contributor of the suburban population growth.<sup>71, 72</sup> Furthermore, the growth of metropolitan population can also be partially attributed to the reclassification of fast-growing non-metropolitan towns as new metropolitan areas.<sup>73</sup> In the latter half of the 20<sup>th</sup> century, changes in the wider economic structure have favored population growth in non-metropolitan counties adjoining metropolitan areas and in the outer fringe metropolitan counties with attractive natural amenities (i.e. climate, topography, body of water) as these encompass areas with an appealing environment and employment potential.<sup>74</sup>

By the twenty-first century, metropolitan areas share some common physical and social characteristics that set them apart from non-metropolitan areas.<sup>75</sup> For example, employment has become highly dispersed throughout the metropolitan area, and more than half of the labor force is employed outside the central city in low density office parks or suburban business districts.<sup>71, 75</sup> Metropolitan areas have a range of higher education academic settings, and these not only serve as amenities to local residents but to help lure non-local students, and stimulate economic growth.<sup>75</sup> Within metropolitan areas, central cities in recent decades have also been investing in renovating traditional city attractions such as sports arenas and convention centers, and adding venues designed to attract tourism and businesses. The central city setting helps draw various other businesses, as well as contribute to the diverse social environments often attributed to them. In contrast, physical environments that can help organize similar type of social interaction as found in central cities tend to wane as the *population* size of the core-based statistical area decreases and may be absent in many non-core counties. Brown and colleagues<sup>76</sup> compared socio-economic characteristics of the population, and the availability of services and facilities in MSAs,

Micropolitan and non-core counties. Socioeconomic characteristics such as the proportion of the population with college degrees and in employment classified as professional, administrative or technical employment increased with urbanization category. Micropolitan areas were an intermediate between MSAs and non-core counties in terms of the availability of services and facilities; however, the majority of non-core counties lack a four-year college, a library with multiple branches, a museum, as well as other amenities such as public transportation services and local media sources.

### Population Change

Population change is the combined measure of births, deaths and migration that informs on the pace of population growth or decline in a defined area over time.<sup>60</sup> Population growth represents the net population increase in an area based on natural increase (births minus deaths) and net migration (immigration - emigration).<sup>60</sup> Migration has a greater influence on population growth than natural increase as birth and death rates are relatively stable across the county.<sup>77, 78</sup> Based on decennial censuses population counts, the 1990 U.S. population grew 13.2% by 2000, and this represented a faster growth than observed in the previous or subsequent decade (9.8 % and 9.7%, respectively).<sup>79</sup>

Historically, metropolitan areas have had a faster population growth than non-metropolitan areas because they tend to be centers for commerce.<sup>80</sup> However, the pattern of growth between metropolitan areas varies according to the strength of their industry mix to attract new residents as prospering industries change over time. Since the 1970s, large metropolitan areas with a strong manufacturing-based industry for example began to lose population as manufacturing businesses declined, while those with more diversified industries remained less vulnerable to economic changes and population instability.

In general, factors associated with population growth in U.S. cities include a higher distribution of college graduates and household incomes, and a lower proportion of unemployment and poverty.<sup>81</sup> Within metropolitan areas, places that gain more population have different socio-economic and built environments than the places that gain less population. Characteristics of places outperforming the population growth within their own metropolitan area include having more residents with higher income, more newly built housing and more out-of-state born residents; correspondingly, characteristics of places underperforming the population increase within their own metropolitan area include having a lower median household income, older housing, and fewer owner-occupiers.<sup>82</sup>

### Urban Environments at Higher Risk of STI/HIV, and Urbanization

Individuals engaging in high risk behaviors, or core group members, are disproportionately burdened by STIs/HIV, and have been important for providing a theoretical explanation for the endemicity of these infections in the population.<sup>83</sup> Specific subpopulations such as sex workers, injecting drug users and men who have sex with men have been recognized to be at higher risk of STIs and HIV. However, it has also been recognized that persons with diagnosed STIs and HIV tend to cluster in geographic areas.<sup>83-86</sup> To differentiate individuals who engage in high risk behaviors from the geographic clustering of infection, terms such as geographic core or risk spaces have been devised to update core theory of STIs.<sup>86, 87</sup>

The concept of risk spaces attempts to explain that it may not be the same individuals who engage in high risk behavior over time, but an environment that supports the replenishment of individuals engaging in high-risk behavior and with a high burden of STIs and HIV. Gesink and colleagues<sup>86</sup> mapped census-tract-level syphilis rates in San Francisco between 1985 and 2007, and found that the risk of infection was almost five times higher in a specific geographic area than the rest of the city, even during years of low infection and the subgroup most at risk during the two high infection periods differed (African American heterosexual crack-users versus White and Hispanic men who have sex with men). Individuals affiliated to high-infection areas may play an important role in also initiating and maintaining infection outside these geographic areas.<sup>86, 88-90</sup> Wallace and Wallace<sup>89</sup> for example, mapped HIV/AIDS rates in the New York Metropolitan area from the early 1980s to 1990 and displayed a regionalization of increased rates of HIV/AIDS from an infection epicenter to surrounding metropolitan counties over time via commuting paths. Places characterized by high population density, low socioeconomic status and an absence of males relative to females of compatible age has been associated with the geographic clustering of STIs.<sup>83</sup>

Galea and Vlahov<sup>91</sup> literature review of mechanisms of how urban environments affect health suggest that these may be understood through broad themes including the physical environment and social environment. The built environment, a component of the physical environment, has been associated with various health outcomes including the risk of STIs.<sup>91-94</sup> Characteristics of the built environment are thought to characterize social conditions. Residents of disadvantaged neighborhoods may have reduced licit employment opportunities, and limited access to cultural learning to enable upward economic mobility.<sup>95, 96</sup>

Conditions that perpetuate residents' socioeconomic barriers may contribute to communities' physical disinvestment,<sup>97-99</sup> which may also facilitate meaningful spaces where a subgroup of people may organize high risk activity that support infection spread.<sup>100, 101</sup> Residents of disadvantaged areas may have a higher risk of STI/HIV infection because of an increased chance of coming into contact with an infected partner.<sup>21,</sup>

102-104

Physical environment and social environment encompass the spatial geographic locations and social networks that link individuals to societal structural factors.<sup>58</sup> Policies in response to rapid urbanization and to promote urbanization have contributed to the physical and social disinvestment of neighborhoods in metropolitan areas that may have given way to social conditions that tend to maintain a wide range of adverse health outcomes including STI/HIV.<sup>71, 105, 106</sup> Manufacturing employment opportunities in the early 20<sup>th</sup> century, for example, stimulated the migration of African Americans from Southern agricultural farms to the cities.<sup>71</sup> However, racial zoning and neighborhood redlining systematically restricted housing options and home ownership within metropolitan areas for minorities and low-income populations. Federal Housing Authority guidelines initiated in the 1930s and legally practiced through the late 1960s discouraged private mortgage investors from financing in city minority neighborhoods, thus reducing the property value and increasing the physical deterioration in these areas. The notable growth of suburban population by the midst of the 20th century that needed to commute to central cities for work also directly impacted the population in low-income minority city neighborhoods. Highways were sometimes built through many high-crime minority city neighborhoods to intentionally dismantle them and force the relocation of its residents.<sup>71</sup> The force the relocation of residents in poor city neighborhoods through cuts in public services has been found to expedite housing deterioration, offer limited options where low-income minorities could live, increase home overcrowding, and promote residential instability.<sup>107</sup> Residential instability has been suggested to impact residents' solidarity to respond to reductions in public services and propensity to intervene with emergency units upon witnessing someone in crisis or involved in an illicit activity that increases the risk of STI/HIV.<sup>108, 109</sup>

Since the early 1980s, suburbs have been developing into notoriously relatively dichotomized communities as a result of locally-derived policies to attract new investments in the build environment for commerce and population growth of high tax base. With the rapid population growth in the suburbs since

the latter half of the 20<sup>th</sup> century, suburban jurisdictions have competed to meet the demand for green-field developments for office parks and large houses of low residential density.<sup>99</sup> For example, locally-derived zoning practices that make housing more expensive such as large-lot zoning, minimum house size requirements, and bans on secondary units are in effect across the United States, and have become vital to new development projects in low-priced undeveloped land in the outer fringe areas. In contrast, suburban jurisdictions closer to the central city, and many once vital centers of manufacturing activity, are not attracting new investments in the built environment.<sup>71, 99</sup> Housing, roads, schools are substandard in comparison to the newer suburban neighborhoods, or have deteriorated due the economic instability driven by the pattern of deindustrialization.<sup>99</sup> Zoning practices have deliberately separated modern from aging suburban neighborhoods, which can perpetuate social barriers. Housing with high property taxes and maintenance costs block lower income racial and ethnic minorities from living near or attending well-resourced community amenities, hindering social mobility.<sup>98, 105</sup> Suburban minority neighborhoods housed fewer jobs and of lower pay than non-minority suburban neighborhoods.<sup>96</sup> This contributes to neighborhoods with lower revenues for local institutions and disinvestment in the built environment,<sup>97</sup> which may also give rise to risk spaces for STIs/HIV.

#### Urbanization Level and Sexual Risk Behavior

Comparisons of sexual risk behaviors between residents of metropolitan and non-metropolitan counties at the national level are few, and they have not offered a consistent pattern for the prevalence of high-risk behaviors. Based on findings from the National Survey of Family Growth and the General Social Survey, there was no statistical difference in the prevalence of multiple partners in the past year by metropolitan status for men (26.7% and 21.7%) or women (11.7 versus 11.6%).<sup>110</sup> Metropolitan women were slightly more likely than non-metropolitan women to report having a recent sexual partner who was not monogamous (5.5% versus 4.4%), which puts metropolitan women at higher risk of infection from partners with an increased opportunity to acquire and expedite transmission among concurrent partners.<sup>110</sup> The potential protected effect of monogamous relationship among non-metropolitan residents is, however, counteracted by low-levels of condom use relative to metropolitan residents found at the national level and in special populations.<sup>110-113</sup> A national comparison of condom use at last sex with a casual partner between residents of metropolitan areas (large and small), and residents of non-metropolitan areas indicated

that there was a gradual increase in the prevalence of unprotected sex by decreasing urbanization level (30% in large metropolitan, 42% in small metropolitan, and 49% in non-metropolitan).<sup>111</sup>

### Population Change and Health

Since the mid-nineteen century, population change has been associated with health outcomes. In England, rising mortality rates were observed in districts gaining population that had a rise in manufacturing industries, while declining mortality rates were observed in districts losing population that remained relatively agrarian.<sup>114</sup> By the early 20<sup>th</sup> century, a negative association between population increase and mortality began to emerge in developed countries.<sup>115-118</sup> An ecological study in France that compared population changes and mortality from 1975 to 2006 found that a 1% increase in population growth was associated with an average standardized mortality ratio decrease of 2.1% in pre-mature all-cause mortality, with stronger effects for violent deaths, and alcohol related mortality.<sup>117</sup> The negative association between population increase and mortality rate has been thought to be embedded in factors associated with the dynamics of economic prosperity.<sup>119</sup> The study in France also stratified the analysis by quintiles of deprivation index in the communities (i.e. income, education, occupation and employment).<sup>117</sup> Differences in mortality between areas that sustained population increase above the national average and areas that sustained population loss were wider in the most deprived communities but less divergent in the least deprived communities. The findings support that a sustained population loss in disadvantaged areas had an accumulative effect on factors contributing to pre-mature mortality, but for areas that were better off in terms of human capital and employment resources, the association between population loss and pre-mature mortality was weaker.

The opportunity for selective migration is thought to contribute to unhealthy environments. Populations residing in areas of persistent poverty are more likely to have limited access to cultural learning to enable upward economic mobility.<sup>95</sup> The isolated social system makes it more difficult for those most marginalized to cope with economic hardships and to out-weight the cost- benefits of migrating.<sup>120</sup> The loss of human capital and labor demand also thwarts economic recovery and increases the incentive for depopulation.<sup>120</sup> The out-migration of more educated and skilled population impacts the economic resources and opportunities of those who remain.<sup>77</sup> The loss of employment opportunities and



revenues produced by the loss of human capital can impact funding of local institutions and municipal services including those allocated to public health.<sup>97, 121</sup>

Population change associated with migration has important implications for infectious diseases.<sup>1</sup> In international settings, labor migration of working-aged men has been associated with high sexual risk behavior, including unprotected sex with sex workers, and the spread of STI/HIV at destination areas, hometowns and along major travel routes.<sup>122-129</sup>

The population of the United States is highly mobile. Of the 120 million people who moved residence from 1995 to 2000, 54% moved within the same county, while 21% moved to another county, 18% moved to another state, and 6% previously lived abroad.<sup>130</sup> There is limited research on domestic migration and STIs/HIV risks.<sup>131-133</sup> Lansky and colleagues<sup>45</sup> found that two-thirds of HIV/AIDS diagnosed cases residing in non-metropolitan and small-sized metropolitan counties of the Southeastern U.S. had previously lived in another county for at least one month during the time before diagnosis. Reports of Latin American immigrant men in non-traditional immigrant gateway areas in the U.S. have also been found an elevated prevalence of risk factors for STIs/HIV.<sup>43, 44, 46</sup>

#### *Urbanization Level and Composition of the Population*

The demographic and economic characteristics of the population differ by urbanization level.<sup>70, 134, 135</sup> Differences in demographic and economic characteristics influence the magnitude and types of health problems observed by level of urbanization.<sup>134</sup> There is greater predominance of females with higher levels of urbanization. The sex ratio of males to females is 94.6 in central cities, 96.9 in suburbs and 98.2 in non-metropolitan areas.<sup>70</sup> The same pattern in sex ratio is observed among 15-49 years old.<sup>136</sup> The age structure of the population tends to be younger as levels of urbanization increase, and the median age of Hispanics and African Americans is lower than that of the non-Hispanic-white population.<sup>70</sup> African Americans, Hispanics and Asians are more likely to live in metropolitan areas than other racial/ethnic groups, but African Americans are more likely to reside in central cities.<sup>70, 135</sup> A higher percent of the population in central cities and in non-metropolitan areas lives below the poverty level.<sup>134</sup>

#### *Goals of the Dissertation*

In light of the limited understanding of men who buy sex from sex workers, and the paucity of research measuring the influence of urbanization on key high-risk groups for STIs/HIV, we sought to

examine the relationship between urbanization and men who buy sex from sex workers. We propose to first compare an array of STI and HIV risk factors and the history of STIs and HIV testing between men with and without a history of buying sex to understand factors that elevate their risk to infection and assess their burden of infection in the general U.S. population. We further propose to examine the prevalence of male clients of sex workers by urbanization level, and the process of urbanization in the U.S.

The National STD Behavioral Measurement Experiment study, a probability sample of English speaking adults residing in U.S. households with a landline telephone in 1990-2000 measured a wide range of STI/HIV risk behaviors and screening history. This provided us the opportunity to compare the prevalence of substance use, sexual behavior, STI and HIV screening history between clients of sex workers and non-clients in the general U.S. population. Additionally, county and state codes corresponding to survey participants' household location allows us to link survey data to government sponsored datasets. Specifically, survey data was linked to the National Center for Health Statistics Urban Rural Classification Scheme for Counties to compare the prevalence of clients by urbanization level. Survey data was also linked to non-institutionalized population counts from the 1990 to 2000 U.S. censuses to examine the prevalence of clients by decennial population changes.

### **Pathways and Theories Linking Urbanization and Men Paying for Sex**

Our understanding that urbanization is associated with sexual risk behavior is informed by the perspectives of social network theory. We posit that social forces such as urbanization operate through relationships between groups and individuals<sup>137, 138</sup>, and that HIV sexual risk behavior is influenced by both individual and personal social networks<sup>18, 139-143</sup>. Urbanization is posited to influence the structure and characteristics of personal social networks, thus modifying social constraints on sexual partnerships. In specific, urbanization is thought to be associated with buying sex because: 1) urbanites may be weakly involved in multiple social networks; 2) social network members can convey information and control on sexual partnerships; and 3) urbanization might lead to an absence of stakeholders in the social network who might discourage high-risk sexual relations in urban spaces.

#### **1. Multiple and More Weakly Connected Social Network Membership in Urban Settings**

In the theoretical framework called 'community liberated', Wellman<sup>137</sup> posits that social ties providing solidarity are prevalent and important in modern-day urban areas, but that the demographic and

economic changes that transformed rural into urban areas had an effect on social network structure and characteristics. Urbanization transformed primary social ties away from densely-linked and spatially bounded social networks. Wellman<sup>137</sup> posits that modern-day urbanites are more likely to be involved in multiple social networks, where most members may not be closely linked. The separation of work, residence, and kin relationships facilitates the development of ties by setting and relationship type.

There are several factors posited by Wellman<sup>137</sup> that contribute to multiple and more weakly connected social network membership in urban settings. Modern-day urbanites are highly mobile, which weakens ties with those left behind and delays the formation of new strong ties at the destination area. Spatially dispersed primary ties increase the likelihood of forming social ties with others who also have spatially dispersed primary ties. Communication and transportation resources may, however, enable the maintenance of primary ties that are spatially dispersed. The geographic size, density, socio-demographic diversity, and the widespread distribution of venues for social interaction in urbanized areas increases the opportunity to access diverse, loosely connected, social networks.

Findings from the 1985 General Social Survey also support the notion that personal networks may be structured differently for rural and urban residents.<sup>144, 145</sup> Rural residents, defined as those living in areas with less than 10,000 people, were, on average, more likely to have smaller-sized social networks, higher density among ties (i.e. ties know each other), higher boundedness (i.e. defined to a traditional grouping such as kin, neighbor, neighbor's kin), higher multiplexity (i.e. superimposed roles), and ties of longer duration than urban residents (i.e. those living in areas of 10,000 people or more)<sup>144</sup>. A separate analysis that differentiated rural residents (i.e. counties with fewer than 10,000 people), residents of the central cities in the 112 largest metropolitan areas and residents of all remaining areas found that social ties identified as friends had a higher density among rural residents compared to residents in urbanized settings.<sup>145</sup> Reports on the social networks of adults in urban settings indicate that, on average, half of the primary ties are kin relationships; these kin relationships tend to be densely connected.<sup>137, 146</sup> In contrast, it was the remaining unrelated primary ties that were weakly connected in the personal network, thus supporting the notion that urbanites tend to be part of multiple, loosely connected social networks.<sup>137, 146</sup>

## 2. Social Network Members' Information and Control

Social environments are pathways through which information and control of behavior can be conveyed.<sup>147, 148</sup> Laumann and colleagues' theory of sex markets<sup>149</sup> proposes that social network members can convey information about where to search for sexual partners and potential ties to set-up sexual partnerships. The multiple and more weakly connected social network memberships in urban settings suggest that, on average, urbanites may have more informational resources over sexual partnerships than those residing in rural areas. Larger personal networks may increase the opportunity to meet potential sexual partners of varying HIV risk.<sup>141</sup>

The theory of sex markets<sup>149</sup> also posits that strong social network members such as parents or close friends may exercise control over sexual partnerships by acting as stakeholders, promoting or discouraging some types of sexual behavior and partners. Latkin and colleagues<sup>150</sup> have reported that the larger personal networks among urban residents were associated with having multiple recent partners, and that larger and less dense personal networks were associated with having exchange relationships. Less dense networks may include social ties that are not close and buying sex may be substitute for the supportive network members or ties are less concerned about discouraging a member from having high risk partners.<sup>149, 151</sup> A stronger presence of family members in the social networks secures greater control to surveil and approve sexual partnering that are perceived to be moral or safe for their network member, and consequently the family group.<sup>147</sup> Findings from Latkin and colleagues<sup>18</sup> support the role of family in inhibiting high HIV risk partnerships. Urban men who had bought sex were associated with having personal networks with fewer kin members than men who had not bought sex. The smaller size, the greater density, and multiplexity of roles in the personal networks of adults in rural areas, versus urban areas, may increase the opportunity of stakeholders to regulate potential sexual partners of varying HIV risk.

### 3. Absence of Stakeholders Regulating Sexual Relations in Urban Spaces

Sex markets theory<sup>147</sup> also posits that personal social networks' influence on sexual partnerships does not occur in isolation. The geographic space that contains the settings to meet different types of sexual partners (i.e. exchange, long term), and is also feasible to travel and affordable for maintaining sexual relations, physically bounds sexual behavior. These settings have sexual cultures that provide criteria for organizing sexual partnering (e.g., visual cues of the sexual orientation of venues, information about the prospect and acceptability of meeting a casual sex partner, beliefs about paid partners, etc.). The

degree of embeddedness in the social network, sexual culture and relations to institutions<sup>a</sup> (i.e. religion, work) within a relevant geographic area, help narrow sexual choices and push individuals into choosing particular sexual partners and engaging in particular high HIV risk behaviors.

Urbanization might lead to an absence of stakeholders. Locales experiencing population growth may have a greater proportion of its residents without locally-bounded primary ties who may act as stakeholders within the local context where sexual partnering occurs. Supporting Wellman's 'community liberated' framework<sup>137</sup>, Oliver<sup>146</sup> observed a lack of kin, co-members of organizations and co-workers living in the same neighborhood among African Americans living in a suburban neighborhood where African Americans were mainly recent arrivals<sup>146</sup>. Family and close friends who are physically remote may have reduced influence to competently guide sexual partnering and discourage partners of high HIV risk.<sup>149</sup> Mahay and Laumann<sup>149</sup> reported that heterosexual men living in an area where few residents were long-term residents and most did not have relatives living in the same city were less likely to share mutual friends with their last sex partner or have a relative who knew of their last sex partner than men living in an area with more population permanency and a strong family presence in the same city. A geographic area with rapid urbanization where residents are devoid of locally-bounded stakeholders may also shape a sexual culture that better organizes casual and transactional sexual relations than long-term ones.

The foregoing theoretical perspectives provide the most plausible basis for inferring an association between urbanization and the prevalence of male clients of sex workers. However, another viewpoint can be articulated, and it leads to the opposite prediction that men living in urbanized areas with *declining urbanization* should report an increased prevalence of buying sex. The counter-rationale follows from the speculation that stakeholders regulating sexual relations in such areas may be more approving of high-risk behaviors. Mahay and Laumann<sup>149</sup> reported that men in an economically disadvantaged area, where the majority of residents were long-term residents highly embedded in their family and neighborhood social ties, were more likely to engage in certain high HIV sexual risk behaviors. Under this circumstance, smaller and denser social networks may position an individual into HIV risk behaviors and reinforce the pattern of high risk behavior when the individual uses the local high risk network as reference to guide behavior<sup>152</sup>. So, for example, the proportion of active drug users in the social network has been associated

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<sup>a</sup> The authors also indicate that institutional control over sexuality tends to be indirect and partial, leaving family and friends to exercise a greater role on determining sexual partnering within a culturally and spatially bounded setting.

with having multiple recent partners,<sup>151</sup> and any drug use in network has been associated with buying sex and selling sex<sup>18</sup>.

Strong ties that are predominantly locally-bounded occur in disadvantaged areas, and they may isolate individuals from other social networks that can influence behavior to reduce HIV risks. Locally-bounded ties in de-urbanizing and economically disadvantaged areas may also isolate individuals from opportunities for cultural learning that would enable them to bridge to social networks and thereby enable greater social and economic mixing<sup>95</sup>. Isolated social system makes it more difficult for those most marginalized to flee the local economic hardship.<sup>120</sup> The reduced avenues to access legitimate economic opportunities among individuals staying in de-urbanizing and economically areas may favor the growth of an illicit drug economy, consumption and related violence, and sexual risk taking<sup>100</sup>.

### **Specific Aims**

The specific aims of this dissertation are as follows:

1. To examine the relationship between STIs and HIV behavioral risk factors and men who buy sex workers, in the U.S. general population, and to examine the relationship between urbanization level and male clients of sex workers. *Hypotheses: men with a history of buying sex will be associated with increased risks of STI and HIV infection, while urbanization level is positively associated with the prevalence of clients.* (Chapter 3)
2. To examine the relationship between relative population change in metropolitan counties and males purchasing of sex. *Hypothesis: higher prevalence of male clients will be associated with counties that experienced population decline/marginal change.* (Chapter 4)
3. To clarify the relationship between population growth and the prevalence of male clients, we examine the association between county-level population increases with the prevalence of male clients within the regional context of population change. (Chapter 5)

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**Table 1.1. Distribution of the 2000 U.S non-institutionalized population by urbanization level.**

Urbanization level	Number of Counties	Population size	Percent of U.S. population
Core-based statistical areas	1,321	250,766,322	89.1%
Metropolitan Statistical Areas (MSAs)	838	225,553,864	80.1%
Central cities of MSAs of 1 million people or more	63	83,815,794	29.8%
Fringe counties of MSAs of 1 million people or more	250	56,708,727	20.1%
MSAs of 250,000 to less than 1 million people	321	62,620,528	22.2%
MSAs of 50,000 to less than 250,00 people	204	22,408,815	8.0%
Micropolitan Statistical Areas	483	25,212,458	9.0%
Non-core based statistical areas	1,820	30,665,584	10.9%
Total U.S. (excluding U.S. territories)	3,141	281,431,906	100%

Source: Population size and percent calculated from the U.S. Census Bureau 2000 Summary File – 1, and categorized based on the NCHS urban-rural classification for counties.

## **Chapter 2: Methodological Issues**

## The Construct of Urbanization

Urbanism and urbanization are related concepts, but they do not represent the same phenomenon. Urbanism (or urbanization *level*) is defined as the impact of living in urban areas at a given point in time.<sup>1</sup> Urbanization is defined as the increase in the proportion of the population living in urban areas.<sup>2</sup> While an estimate for urbanization is straightforwardly quantifiable, it is intrinsically linked to how urban and its rural residual are construed. Country-specific official definitions for urban and rural areas may be based on the geographic boundary of a city, population size, density, or they may also include commuting exchange with areas adjoining a population core.<sup>1</sup> The official definition of urban-rural classifications in the U.S. is detailed in the background section.

Urban and rural environments are thought to vary along a continuum that extends beyond the main factors of population size and density. In contrast to rural environments, increasing urbanized environments concentrate social and economic diversity, as well as the availability and accessibility to various resources such as basic services and healthcare.<sup>3,4</sup> Dahly and colleagues<sup>5</sup> developed a scale for urbanism from measures of population size, density, and the availability of infrastructure and services in an area (i.e. communications, transportation, education, health, and merchandise stores). Novak *et al.*<sup>6</sup> and Jones-Smith *et al.*<sup>7</sup> developed urbanism scales that included analogous features to the scale by Dahly and colleagues<sup>5</sup>, but also added variables to quantify agricultural-related employment and distance to transportation and merchandise stores. In general, the classification of geographic areas on an urban-rural continuum has informed on various health disparities and health care needs of populations living in different strata of urbanism<sup>8</sup>. For example, in the U.S., it has been found that more urban counties tend to have a greater and more convenience supply of health care providers than rural counties<sup>9</sup>.

While socio-demographic, environmental, and economic characteristics are not used to define metropolitan, micropolitan and non-core based counties in the U.S., (the official base for classifying counties into an urban-rural continuum), the diversity of these domains increases relatively linearly by urbanism<sup>4</sup>. Socio-demographic characteristics comprise one domain that may influence the magnitude and types of health risks affecting communities at each urbanization level, including risks of STIs<sup>9-11</sup>. For example, in terms of socio-demographics, there is a greater predominance of females in areas with higher levels of urbanization, thus affecting the sex ratio of the population<sup>12</sup>. Sex ratio imbalances for men and

women of reproductive age may influence STIs risk by fostering conditions that favor sexual concurrency and expedite STI transmission between partners<sup>13</sup>. African Americans and Hispanics are the racial/ethnic minorities with the highest burden of STIs including HIV. African Americans and Hispanics are also more likely to live in metropolitan areas than other racial groups, but only African Americans are more likely to live in central cities<sup>14</sup>. In addition, the age structure of the population tends to be younger as levels of urbanization increase, and adolescents and young adults are at higher risk of infection than older aged adults. The median age of Hispanics and African Americans is lower than that of the non-Hispanic-white population.<sup>12</sup> More urbanized areas concentrate a larger proportion of international migrants, and an elevated prevalence of STI risks have been reported among foreign born men.<sup>14, 15</sup> A higher percent of the population in central cities and in non-metropolitan areas lives below the poverty level, and poverty may increase vulnerability to STIs/HIV risks.<sup>16</sup>

Despite extending official urban-rural definitions using more categories along an urban-rural continuum, any single urbanization level can be inadequate to describe counties covering large areas as it may fail to capture the spatial heterogeneity of the population<sup>9, 17</sup>. Therefore, analyses in this dissertation will account for specific socio-demographic distributions that vary by urbanization and that are believed to impact risk of STI transmission; These include: age distribution, predominant racial/ethnic group, sex ratio (for ages 15 to 49 years old), percent foreign born, and percent below poverty.

It is important to recognize that variables which distinguish urban from rural environments along a continuum may not be fully interchangeable with variables relevant to urbanization because the degree of population increase occurs unevenly within metropolitan areas<sup>18, 19</sup>. Urban places with strong population growth have different characteristics than those with negative or weak population growth. Glaeser and colleagues<sup>20</sup> examined economic, social and environmental characteristic associated with population growth in U.S. cities and in metropolitan areas from 1960 to 1990. Glaeser and colleagues<sup>21</sup> also examined the temporal consistency of variables that predicted population growth in previous decades with population growth that occurred from 1990 to 2000. Table 2.1 lists the domains, rationale, variables extrapolated from Glaeser *et al.*'s findings<sup>20, 21</sup>. The direction of the statistically significant association between a variable and urbanization is denoted in parenthesis. Similar features to those listed in Table 2.1 have also been generally associated with urbanization in other peer-reviewed literature<sup>22, 23</sup>.

In overall, human capital is thought to have an important influence on population growth because it represents places with potential employment growth that can draw population from other areas. Human capital alone is, however, insufficient to explain population growth. It can be inferred that factors driving urbanization also include industry and a consumer preference for newer technologies. It can also be inferred from this table that consistent predictors of urbanization for the latter half of the 20<sup>th</sup> century do not include a strong representation of socio-demographic characteristics. Median age of the population was one exception; It was an important predictor of population growth as younger adults tends to move more than older adults, and growing cities are, perhaps, more likely to appeal to this demographic. Gleaser and colleagues<sup>20</sup> also examined racial composition and found that the percent of blacks in area is weakly negatively associated with population growth, but this association disappears when variables pertaining to education, manufacturing industry and unemployment are included in the model. This suggests that urbanization encompasses trends in economic activity and consumer preferences that are not associated with race, although race may be correlated with economic disparities.

### **Urbanization versus Socio-demographic Factors**

To demonstrate that urbanization is different from or a more encompassing concept than other social/demographic variables requires reframing the question to whether social/demographic characteristics are mediators or confounders in the relationship between urbanization and a history of buying sex. To frame it as mediation, the question becomes whether the association between urbanization and the history of men buying sex may be explained by the relationship between urbanization and socio-demographic characteristics of an area. To examine whether the association between urbanization and buying sex is largely the result of demographic compositional characteristics involves the following analytical steps: examine the associations between urbanization and buying sex, between urbanization and each of the socio-demographic characteristics, and between urbanization and buying sex in a model that includes the socio-demographic characteristics. In mediation analysis, we might find that the strength of the association between urbanization and the history of buying sex would be attenuated and perhaps become statistically insignificant when socio-demographic characteristics are included in the model. This would statistically support the inference that urbanization is not a different or more encompassing concept than compositional characteristics. Compositional characteristics, however, may only partially mediate the relationship



between urbanization and buying sex. Under this circumstance, the strength of the association between urbanization and buying sex would be attenuated but remain statistically significant. This would provide statistical support that the relationship between urbanization and buying sex is not completely explained by demographic composition and that the influence of urbanization operates through other mechanisms. Presenting statistical support that compositional characteristics of interest are confounders, and not mediators, would entail the same analytical steps.

This dissertation conceptualizes socio-demographic characteristics as confounders. One of the goals of this dissertation is to investigate whether there is an association between urbanization at the county-level and the distribution of men who report buying sex, independent of county-level socio-demographic differences and men's individual characteristics that may distort the relationship of interest. External evidence supports the assumption that the social-demographic characteristics of the population that are included in this study were unevenly distributed in urban areas *prior* to this study's assessment of urbanization. We believe that the disproportional distributions of compositional characteristics of the population within metropolitan counties are largely the consequences of historical influences that preceded our study, not the result of urbanization during the study period. Within metropolitan areas, central cities have a higher concentration of blacks, Hispanics, foreign born, and populations living below poverty. This occurs because of several factors, such as: central cities have been traditional gateways for international migrants<sup>24</sup>; central cities were the main destination area for the exodus of Blacks from agricultural areas in the early 20<sup>th</sup> century<sup>24, 25</sup>; historical racially-biased housing policies restricted housing options for minorities fostering social disadvantage and economic immobility within central cities relative to whites and international migrants with human capital<sup>24</sup>; geographical annexation of non-metropolitan counties into existing metropolitan areas and the formation of new metropolitan areas in previously designated non-metropolitan areas that have a higher distribution of white, older population than central and inner ring counties<sup>26</sup>. Factors linked to sprawl and local economic mix are negatively linked to older central cities<sup>21, 27</sup>, and thus negatively associated with central city socio-demographics. Central cities were initial areas of settlement, thus retain a higher distribution of older housing stock, as well as more established public transportation systems. Automobile technology facilitated the shift of the population to the suburbs, and away from perceived crowded and outmoded small-style housing. Manufacturing industry built around

inner ring suburbs were lucrative industries for much of the first twenty-century. However, shifts in the employment towards service sector jobs around the latter half of the mid-20<sup>th</sup> have also shifted employment from central cities, favored job decentralization and office parks sprawl, and has restricted access to jobs for economically disadvantaged populations without a car<sup>24, 27, 28</sup>.

Overall, the relationship between urbanization and socio-demographic characteristics is historically determined, and it is perpetuated with further urbanization trends. The objective of this dissertation is to examine the relationship between urbanization and men's sexual risk taking independent of confounding socio-demographic characteristics, a relationship that has not previously been well described.

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**Table 2.1. Domains, rationale and variables for measures associated with population growth for 1960 to 2000 in U.S. cities and metropolitan areas.**

Domain	Rationale	Variables (direction of association)
Human capital	High human capital produces new ideas for economic growth to retain and attract population, including knowledge spillover to other professional fields.	<ul style="list-style-type: none"> <li>• Percent age 25 and older with high school or higher degree (+)</li> <li>• Percent age 25 and older with college degree or higher (+)</li> <li>• Per capita income (+)</li> <li>• Percent income below poverty (-)</li> </ul>
Local economic production	Diversification of industries to maintain and attract labor. Response to underlying living conditions.	<ul style="list-style-type: none"> <li>• Industry mix percentages [i.e. manufacturing (-), financial/insurance/real estate (+), health services (-), public administration (-), retail (no association)]</li> <li>• Percent civilian unemployment (-)</li> <li>• Public expenditures per capita [(i.e. highways (+))]</li> </ul>
Sprawl	Newer cities built around newer technologies.	<ul style="list-style-type: none"> <li>• Percent driving alone to work (+)</li> <li>• At least 5% of the population takes public transportation to work (-)</li> <li>• Percent housing build before 1939 (-)</li> <li>• Population density (-)</li> </ul>
Consumer demand for pleasant weather	Importance of consumer amenities relative to production.	<ul style="list-style-type: none"> <li>• Average temperatures in January (+) and July (+)</li> <li>• Average annual precipitation (-)</li> </ul>
Socio-demographics	Age influences migration.	<ul style="list-style-type: none"> <li>• Median age of residents (-)</li> </ul>

Source: Extrapolated from writings of Glaeser, Scheinkman and Shleifer (1995) and Glaeser and Shapiro (2001).

## **Chapter 3**

### **Male clients of sex workers in the United States, STI/HIV Risk Behaviors and Urbanization level**

## **Abstract**

Men who have purchased sex from sex workers (“clients”) are at an increased risk of acquiring sexually transmitted infections (STIs) including HIV, and may be at an increased risk of spreading STI/HIV infection to sexual partners. While STIs and HIV infection rates are more commonly higher in large urbanized areas, there are few studies of key high-risk groups by urbanization level in the U.S. This study examines STI/HIV behavioral risks and screening history correlates of clients, and whether their prevalence differs by urbanization level among a U.S. national random sample of men aged 26 to 45 years old (N=469) linked to the National Center for Health Statistics Urban Rural Classification Scheme for Counties. Significance test for associations of categorical variables was based on chi-square tests. Prevalence ratios [PR] with 95% confidence intervals [CI] were estimated using Poisson regression for survey data. The overall prevalence of clients was 14.5 (95% CI, 11.5-18.1) and did not significantly differ between the most urbanized areas and categories for less urbanized areas ( $p=0.565$ ). Compared to men who have never purchased sex, clients had a significantly higher prevalence of history of STIs (PR 3.0, 95% CI, 1.7-5.0) and several high-risk behaviors in their lifetime and more recently, including history of same-sex partners (PR 2.5, 95% CI, 1.5-4.3), sold sex (PR 4.3, 95% CI, 2.6-7.3), and multiple partners in the past year (PR 2.5, 95% CI, 1.6-4.0). The risk-taking behaviors of clients stress their potential role in spread of STI/HIV, and findings support the need for further research to address prevention measures for clients.

**Keywords:** urbanization level, urban-rural continuum, transactional sex, clients of sex workers, sexual risk behavior, United States.

## **Introduction**

Although research on men who buy sex from sex workers (“clients”) is globally limited, clients in diverse settings have been found to have an increased burden of sexually transmitted infections (STIs) and HIV.<sup>1-9</sup> In national surveys conducted in Australia, Britain and China, clients were at least three times more likely to self-report a history of STIs than never clients or non-recent clients,<sup>10-12</sup> and based on convenience samples of clients of female sex workers from countries with a low HIV prevalence (<1%), clients were found to have a two to eighteen folds higher prevalence of HIV than the country-specific HIV



prevalence in the general population.<sup>4-8, 13</sup> Clients' higher risk of STI/HIV infection may be due to the disproportionately higher levels of infection that tend to be experienced by sex workers than that of the general population in many settings,<sup>14-16</sup> and clients other behavioral risks factors that put them at increased risk of acquiring infections (i.e. high partner change, inconsistent condom use, and substance use).<sup>1, 10-12, 17,</sup>  
<sup>18</sup> Both underscoring conditions for which clients may also have an increased risk of bridging STI/HIV infections between sexual partners.

To date, there are no published epidemiologic national estimates of STI or HIV prevalence for men who have purchased sex from sex workers in the United States. Although the assessment of buying sex tends to vary, a few non-probability samples from U.S. metropolitan settings have specifically examined the relationship between men's STI/HIV risks and purchasing sex. Supporting evidence of clients' increased risks for STI/HIV in the U.S. comes from diverse special populations (i.e. among adults involved in transactional sexual relationships, drug users, men who have sex with men (MSM), international migrants, public health clinic patients).<sup>19-25</sup> Among residents of high-risk HIV neighborhoods in New York City that reported having had transactional sexual relationships, numerous partners (median 7) and a high prevalence of unprotected sex with both paid and non-paid partners (43%) in the past year was found for clients (majority men), though a lower prevalence compared to those who had sold sex.<sup>19</sup> A higher prevalence of syphilis (10% and 16%) and HIV (3% and 37%) infection, as well as ever crack-cocaine (23% and 35%) and injection drug use (11%), than found in the general population, was reported by clients of female and male sex workers, respectively, recruited through a newspaper ad in Atlanta.<sup>20</sup> Reiterating clients high risks for STI/HIV found in other major cities, clients (prevalence 9%) recruited from Boston clinics were more likely to report having had multiple partners in a short period of time, were less inclined to use condoms, and were three times more likely to report having received a STI/HIV diagnosis compared to men who had not purchased sex in the past year.<sup>25</sup> While social correlates of men who had purchased sex were examined in a sample of drug users and MSM that resided in either the central city or the suburbs of the metropolitan area in North Carolina,<sup>21</sup> no other report on clients was found for populations living in less urbanized areas, with the exception of reports that included buying sex as one of many STI/HIV risk factors.<sup>26, 27</sup>

Geographic areas where residents have an elevated risk to STI/HIV infection have been commonly inferred from residential information collected for diagnosed cases and subsequently through infection mapping. High-infection areas have been more commonly identified within centrals of metropolitan areas in the U.S.<sup>28-31</sup> Individuals affiliated to high-infection areas may play an important role in also initiating and maintaining infection outside these geographic areas.<sup>29, 30, 32, 33</sup> However, there is limited understandings of the proportion of high-risk population residing outside central cities to potentially influence the spread of infection. Comparisons of adult sexual risk behaviors by urbanization level at the national level are limited, and results supported a slightly higher prevalence of women reporting non-monogamous partners in metropolitan areas, a lower prevalence of condom use in non-metropolitan areas, but a compatible prevalence of recent multiple partners between these areas.<sup>34, 35</sup>

The objectives of this study was to gain a basic understanding of male clients in the general U.S. population using national random sample to examine differences in a range of STI/HIV risk behaviors between clients and non-clients and then to examine the prevalence of clients by urbanization level.

## **Methods**

Survey data were derived from the National STD Behavioral Measurement Experiment (NSBME) study. The NSBME is a probability sample of English speaking men and women aged 18 to 45 years old residing in U.S. households with a working landline telephone in 1999-2000.<sup>36</sup> The study used random digit dialed (RDD) sets of telephone numbers to include all 50 states and the District of Columbia. Telephone interviewers screened 86.5% of the 14,250 generated telephone numbers for residential status and eligible participants in the household. One eligible household member was randomly selected for participation. Of the 2,183 eligible respondents found using RDD method, 1,543 (70.7%) adults were interviewed. The overall response rate as standardized by the American Association of Public Opinion Research (formula RR3) was 57 percent.<sup>37</sup> The NSBME was reviewed and approved by the Institutional Review Boards of RTI International and the University of Massachusetts-Boston.

### *Measure of Urbanization Level*

NSBME study participants were linked to National Center for Health Statistics (NCHS) Urban Rural Classification Scheme for Counties<sup>38</sup> by U.S. Federal Information Processing System (FIPS) codes. This classification scheme is based on the Office of Management and Budget definitions of metropolitan

statistical areas (MSAs), micropolitan statistical areas (MCSA) and residual non-metropolitan counties.<sup>39, 40</sup>

A MSA is a geographic area that has a population of at least 50,000 with an overall population density of at least 1,000 people per square mile in a place within a county or counties, and contiguous counties that collectively share a degree of economic integration as determined by work commuting exchange. MCSA are non-metropolitan counties with a densely populated area of at least 10,000 people but less than 50,000, and any adjoining county to this core where residents share a high level of work commuting interchange. All counties part of MSAs or MCSAs are considered core-based statistical areas. All remaining non-metropolitan counties unassigned to a MCSA are formally decreed non-core based statistical areas (non-CBSA) for the absence of densely populated area.

We adapted The NCHS classification scheme because it places greater emphasis in subdividing MSAs, as these encompass the geographic areas where the majority of the population resides while still differentiating non-metropolitan areas by the presence of an urbanized center. MSAs are subdivided by population size (50,000 to 249,999 people, 250,000 to 999,999 people, and at least one million). MSAs on average share some characteristics that set them apart from non-metropolitan areas in terms of economic, physical and social environments that can help organize more diverse social interaction (i.e. industry mix, colleges, museums, sports arenas),<sup>41-43</sup> including the meeting places to meet sexual partners. However, the number of these characteristics tend to wane as the size of the core-based statistical area decreases and may be absent in many non-core counties. The NCHS urbanization scheme also separates central cities of larger sized MSAs as these differ in demographic, economic, and social characteristics, in addition to population density, compared to suburban counties and smaller sized MSAs. Suburban counties are residential areas that are, on average, the employment location of more than half of the metropolitan labor force, thus setting them apart from its central city as a likely physical boundary that is feasible to travel for establishing sexual relations and that subsequently can influence the spread of infection. The NCHS Urban-Rural Classification scheme allows us to directly compare central city residents to residents in less urbanized areas.

#### *Outcome Measure and Individual Characteristics*

The behavioral outcome, client of a sex worker (referred to as “clients”), was derived from men who answered yes to the question “have you ever had sex with a prostitute, either female or male, or with

someone you paid for sex?” Demographic characteristics of interest were the combined responses to self-identified race and Hispanic origin, current marital status, highest educational attainment, and age. Age in years was also categorized along cut-off levels of STI-risks found for reportable STIs.<sup>44</sup> Sexual risk behaviors examined were the number of lifetime sexual partners, number of sexual partners in the past year, the last time men had a one-night stand (defined as oral, anal, or vaginal sex with a total stranger with whom you never had sex again), ever same-sex sexual partners, ever been paid for sex (defined as anyone, either male or female, ever paid you to have sex with them), and frequency of condom use in the past year. Sexual behaviors were dichotomized into six or more lifetime sexual partners versus fewer, multiple partners (2 or more) in the past year versus fewer, and one-night stand in the past year versus more than one year ago or never. Condom use less than always in the past year was dichotomized as ever unprotected sex versus never unprotected sex. Substance use examined with clients were binge drinking (defined as five or more drinks within a couple of hours)<sup>45</sup> and sex while feeling the effects of alcohol in the past month, marijuana and cocaine use within the past year, and ever intravenous drug use. For those who reported never use or last intake longer than the specified interval are included in the reference group. Due to the overall low prevalence of recent cocaine use in the general population, ever cocaine was also examined. A dichotomous composite of ever cocaine or injection drug use was also created. STI history was based on a positive response to separate questions that asked whether the participant had ever been told by a doctor or nurse that they have gonorrhea or chlamydia. Participants that had previously reported never having heard of the infection were categorized as never having it. HIV-screening was based on a question that specifically asked whether in the past year they had received a blood test for HIV from a doctor or other medical care.

#### County-level Covariates Measures

Compositional differences found by urbanization level<sup>46-49</sup> may be disproportionately associated with factors that facilitate purchasing sex. To reduce potential confounding in the relationship between urbanization level and clients, sex ratio, predominant racial/ethnic group, percent foreign born, median age and poverty ratio, at the county-level, were calculated or obtained from the census 2000 Summary Files 1 and 3, and the 2000 population data from the Area Resource File.<sup>50-52</sup> Sex ratio alters the availability of sex partners and may influence the number and type of sexual partners.<sup>53, 54</sup> Prevalence of purchasing sex may

vary by race.<sup>25, 55</sup> An elevated prevalence of buying sex and STI outbreaks associated with transactional sex have been reported among foreign born men.<sup>23, 24, 56, 57</sup> Experience of having been a client increases with age.<sup>21, 25, 55</sup> Persons of lower socioeconomic status tend to be more likely to live in places with higher levels of dilapidated physical environments<sup>58</sup> which may foster social conditions for high-risk sexual encounters including exchange sex.<sup>59, 60</sup> We included sex ratio for ages 15 to 49 years old and median age for the three largest ethnic/racial groups in the U.S. (Whites, Hispanics/Latinos, and African Americans/Blacks). County's predominant racial composition was calculated into four mutually exclusive categories (non-Hispanic white, non-Hispanic Black/African American, non-Hispanic other race/ethnicity, and multi-ethnic) based on the proportion of the household population in each race/ethnic group in the county relative to the proportion found in the nation. Counties where the proportion of more than one racial/ethnic group was greater than the national average were classified as multi-ethnic.

#### Statistical Analysis

Of the 652 men in the NSBME study, 607 reported ever having had sex and 585 of them answered the outcome question. We restricted the analysis to the 469 men aged 26 to 45 years who reported ever having sex and provided a response to the survey question on buying sex. Male respondents 25 years of age and younger were excluded due to the low prevalence (N=116, 2.3%) of buying sex reported among this age group. Men residing in MSAs of less than one million were combined into one group to reduce variability in our sample. Sampling weights were applied that adjust for the initial probabilities of selection, non-response, and deviations from census population estimates by age, race and sex.<sup>61</sup> Prevalence for categorical characteristics and urbanization level of residence for clients and non-clients were compared using design-based Pearson chi-square tests.

Poisson regression analyses for survey data was used to examine the relationship between urbanization and male clients and calculate unadjusted prevalence ratio (PR), adjusted prevalence ratio (Adj. PR), and corresponding 95% confidence intervals (CI) when sampling weights were applied.<sup>62</sup> The association for each behavioral and STI/HIV screening characteristics with clients was adjusted for age and educational attainment to account for possible differential opportunities to have engaged in these behaviors and access screening. The association between urbanization level and clients was also adjusted for a composite of drug use and STI history which, as priori are associated with the outcome and may vary by

urbanization level. Furthermore, the association between urbanization level and clients was examined as an unweighted analysis that included county-level covariates. The unweighted analysis treats the sample as a population of men randomly selected across the U.S. who reside in different urbanization strata.

Unweighted generalized estimated equations (GEE)<sup>63</sup> models were specified using log link, Poisson distribution with robust variance estimator and an exchangeable within-group correlation matrix structure to account for clustering of participants from the same county. Both weighted analysis and unweighted analysis are intended to test whether there is an association with residing in central cities of large MSAs versus lower urbanization levels (i.e. fringe areas of MSAs of at least one-million people, MSAs of less than one-million people, MCSA and non-core areas) and clients. Our main objective is to examine male clients in the general population, but we also repeated the analysis restricted to men who reported never having same-sex partners (N=424) as infection risk differ by gender of the partners. NSBME participants were interviewed using two interview modes (standard telephone interview or telephone-ACASI), but we combined these responses because there was no association in the reporting of our outcome of interest and interview mode ( $p=0.93$ ). All analyses were conducted using Stata/SE 11.2 for windows.<sup>64</sup>

## Results

The prevalence of men reporting ever having had sex with a sex worker, male or female, was 14.5% (95% Confidence Interval [CI], 11.5-18.1). Table 3.1 shows the prevalence of clients and bivariate analysis for socio-demographic characteristics. The prevalence of clients increased with age, 12.0% (95% CI, 8.3-16.9) among 26 to 35 years olds and 17.1% (95% CI, 12.6-22.7) among 36 to 45 years old (linear  $p<0.05$ ). Men who had not completed college or had attended trade school had a significantly higher prevalence of being clients than men who had completed college (19.7% versus 11.0%, unadjusted prevalence ratio [PR] 1.8, 95% CI, 1.1 to 3.1,  $p<0.05$ ).

Table 3.2 displays the comparison of sexual risk behaviors, substance use, STIs and HIV screening characteristics between clients and non-clients. There were a number of significant differences between the two groups. Clients were significantly more likely to report a number of high-risk sexual behaviors, including: at least six or more lifetime partners ( $p<0.001$ ); history of same sex-partners ( $p<0.001$ ); having had been paid for sex ( $p<0.001$ ); having had a one-night stand in the past year ( $p<0.001$ ); and having multiple partners in the past year ( $p<0.001$ ). Only 17% (95% CI, 9.1-29.4) of clients

reported both having fewer than six lifetime partners and fewer than two partners in the past year compared to more than half (52.1%, 95% CI, 46.8-57.4) of men who had never bought ( $p < 0.001$ , not shown).

However, clients were less likely to have had unprotected sex in the past year than non-clients ( $p < 0.01$ ).

Clients were marginally more likely than non-clients to report that in the past year they have had multiple partners and unprotected sex (17.1%, 95% CI, 10.3-27.1, versus 10.4%, 95% CI, 7.5-14.3,  $p = 0.097$ , not shown).

Sex under the influence of alcohol in the past month was associated with clients ( $p < 0.05$ ), but binge drinking was not ( $p > 0.10$ ). Clients were associated with illicit drug use. More than half (54%) of clients had consumed any form cocaine compared to less than a quarter (22%) of non-clients ( $p < 0.001$ ), and clients had almost a three-fold higher prevalence of history of injection drug use than non-clients ( $p < 0.01$ ). Clients did not differ from non-clients in having received a HIV test in the past year ( $p > 0.10$ ), but were associated with an increased STI history (19% versus 5%,  $p < 0.001$ ).

The association between clients and sexual risk factors, illicit substance use and STI history remained statistically significant after adjusting for demographic characteristics. The association for marijuana and cocaine use in the past year with clients strengthened and became statistically significant ( $p < 0.05$ ) for marijuana and marginally significant for cocaine ( $p < 0.10$ ) in multivariate analysis that included age and education.

Table 3.3 presents the prevalence for male clients in relation to urbanization level of residence. The prevalence of male clients in central cities of large MSAs was estimated to be 15.6% (95% CI, 10.5 to 22.7) and non-statistically different to those residing in less urbanized areas (i.e. fringe areas of large MSAs, smaller-sized MSAs, micropolitan and non-core areas). A similar pattern in the prevalence of clients was observed when we restricted the comparison to males who reported never having same-sex sexual partners [Appendix tables]. Table 3.4 presents the results from the weighted Poisson regression analysis for the relationship between urbanization level and clients, inclusive of all males in the analytic sample. Clients were not associated with residing central cities of large MSAs versus the less urbanized core-based statistical areas after accounting for individual characteristics, but a marginal association with clients was found for men residing in non-core areas versus large central cities. Unweighted GEE regression analysis accounting for county-level compositional characteristics (Table 3.5) reinforced

previous weighted analysis in an association of clients residing in non-core areas relative to large central cities (Adjusted [Adj.] PR, 3.55, 95% CI, 1.26 to 9.98,  $p < 0.05$ ) while supporting no difference in clients by urbanization level in core-based counties. Unweighted multivariate GEE regression analysis accounting for county-level compositional characteristics also supported that the following individual-level characteristic were independently associated with clients: age (Adj. PR 1.05, 95% CI, 1.01-1.08), history of cocaine or injection drug use (Adj. PR 2.98, 95% CI, 1.96-4.54), and history of STIs (Adj. PR 1.94, 95% CI, 1.21-3.10).

## **Discussion**

The first objective of this study was to estimate the size of the population of men who have paid for sex and estimate their associated STI risks. In this national representative sample of U.S. men, we found that one in seven men has paid for sex. In this first study to examine clients in relation to behavioral risk factors at a national level, we found that male clients had a higher prevalence of partner change and behaviors that put them at increased risk of STI and HIV infection either through elevated levels of substance uses or sexual behaviors such as selling sex. Clients had both more recent and lifetime high-risk sexual activities, which is important because this study did not measure when clients bought sex. Although unprotected sex in the past year was very common among both clients and non-clients and clients had a lower prevalence of unprotected sex, our findings indicate that clients should be of considerable concern in the U.S. as they show a disproportionate burden of STIs. We estimate that almost one in five clients had a history of bacterial STIs compared to only one-in-twenty of non-clients. Despite clients' high-risk behavioral profile, they were no more likely than non-clients to have been tested for HIV. These associations remain unchanged when the sample was restricted to men who reported having heterosexual partners only. Our findings of clients' increased sexual risk and history of injection drug use are consistent with recent studies of the general population in other developed countries,<sup>10, 11</sup> and they corroborate domestic findings of clients' increased sexual risks.<sup>25</sup>

The second objective of this study was to examine the relationship between urbanization level, or degree of urbanism, and the purchasing of sex. Our findings indicate that clients were as likely to reside in major cities as other less urbanized locations of the U.S. (i.e. core-based statistical areas). A plausible explanation may be provided by social network theory. Wellman<sup>65</sup> theorized that urbanization transformed



primary social ties away from densely-linked and spatially bounded social networks, and that the separation of work, residence, and kin relationships in urbanized areas facilitates the development of social ties by setting and relationship type. Social network members can convey information about where to search for sexual partners or suggest potential network ties to set-up sexual partnerships. Strong social ties such as with parents or close friends may exercise control over sexual partnerships by acting as stakeholders, promoting or discouraging some types of sexual behavior and partners.<sup>66</sup> It is plausible that urban men, regardless of the size of the core-based statistical area of residence, have the potential for being part of multiple and weakly connected social networks. This in turn, opens opportunities for men to have greater resources for sexual partnerships of varying HIV risk, and it relaxes the control of primary ties to surveil and discourage sexual partnering that is perceived to be unsafe for their network member, and consequently the network group.<sup>66</sup> So, for example, larger and less dense personal networks are associated with having exchange relationships, and men who had bought sex have been associated with having personal networks with fewer kin members than men who had not bought sex.<sup>22, 67</sup>

The prevalence of clients of sex workers was associated with residing in non-core based counties (i.e. the most rural areas) relative to large central cities. This finding should be interpreted with caution due to the small sample number of men residing in non-core counties. Nonetheless, our limited understanding of the social structure of the population in terms of an urban-rural continuum suggests that men in rural areas may have reduced informational resources and experience an increased control from stakeholders when searching for sexual partnerships. Findings from the General Social Survey indicate that, on average, rural residents (i.e. defined as those living in counties with less than 10,000 people) have: smaller-sized social networks; higher density among overall ties (i.e. more ties know each other); a higher density among social ties identified as ‘friends’; a higher multiplexity of ties (i.e. superimposed roles); and ties of longer duration than urban residents.<sup>68, 69</sup> It is plausible that the more cohesive social structure of rural residents (versus urban residents), may be more approving of men having paid partners, or that paid partners may be the type of partners more easily available to men looking for sexual relations outside the range of their closely-knit personal networks. In contrast to core-based statistical areas, non-core areas may be undersupplied with settings offering different types of sexual partners (i.e. exchange, long term, casual) and the commute to maintain non-paid sexual relationships may be costly and time-consuming.<sup>66</sup>

The relationship between urbanization level and the prevalence of men purchasing sex was examined in regression analysis, unadjusted and adjusted for county-level socio-demographic characteristics. Social-demographic characteristics of the population that are included in this study were unevenly distributed prior to this study's assessment of urbanization level, and are largely the consequences of historical influences that also preceded our study.<sup>42, 70, 71</sup> The included socio-demographics are believed to influence STI/HIV risks. Although the inclusion of socio-demographics in the regression model resulted in coefficients for the relationship between urbanization levels and buying sex that were closer to one another, it further reinforced that the average distribution of men who purchase sex does not differ by urbanization level.

It is plausible that any single static urbanization level can be inadequate because the process of urbanization may progress unevenly in different sections of a metropolitan area, particularly if the metropolitan area is widely dispersed geographically. In the U.S., there has been a steady growth of population residing in metropolitan areas over the past decades.<sup>46</sup> The growth of metropolitan population is largely occurring in the suburban counties which have been attributed to annexation of non-metropolitan population into existing metropolitan areas and migration to suburban counties associated with the growth of economic opportunities and infrastructure developments.<sup>42, 72</sup> Furthermore, the increase in core-based statistical areas, in overall, can also be partially attributed to the reclassification of fast-growing non-metropolitan towns as new metropolitan and micropolitan statistical areas.<sup>71</sup>

Population changes within urbanized areas may influence the type of sexual partnerships that are available. Mahay and Laumann<sup>73</sup> reported that heterosexual men living in an area where few residents were long-term residents and most did not have relatives living in the same city were less likely to share mutual friends with their last sex partner or have a relative who knew of their last sex partner than men living in an area with more population permanency and a strong family presence in the same city.

History of STIs and harder drug use were associated with men who had purchased sex, independently of urbanization level. We also observed that the relationship between clients in non-core areas relative to central cities strengthened when we included their history of STIs and harder drug use in the model. Further analysis comparing STI history by urbanization level stratified by the combinations of history of buying sex and harder drug use revealed that STI history was more commonly reported by clients

residing in central cities versus non-core counties, regardless of harder drug use. This suggests that despite the increased reporting of buying sex in non-core-counties relative to central cities, clients in central cities may represent a higher risk group for spreading STIs than clients in the non-core counties.

### Limitations

These results should be viewed in light of several limitations. This study did not measure where clients bought sex in relation to current residence to provide information on the potential of STI/HIV spread and to provide guidance on how to better reach the population of male clients for further research. A relatively small geographical distance between client-sex worker partnerships was reported in samples from central cities.<sup>74, 75</sup> A better understanding is needed for populations residing outside central cities which tend to be more dependent on automobile transportation. Efficient highway systems may shorten commuting time for traveling longer geographical distances and thereby widen the geographical spread of infection.

Since this is a secondary analysis, our analyses were restricted because several measures pertinent to the buying of sex were not collected including: gender of the sex worker, how long ago contact occurred, how often, constancy of venue type, whether paid sex was unprotected. Information in these topics would have allowed us to examine clients' heterogeneity in infection risk. Based on domestic convenience samples, men buying sex from a sex worker *only once in their lifetime* may be uncommon,<sup>23, 76</sup> and unprotected sex with someone paid to have sex varies by type of sexual activity and population.<sup>19, 22</sup> The present study is also based on a survey with relatively small sample size which diminishes the power to detect associations in our analyses. Estimates derived from telephone surveys may also under represent adults living below the poverty threshold, less educated, racial/ethnic minorities and those living alone or with roommates because of the greater odds for persons with these characteristics to reside in households without telephone service.<sup>77</sup> However, our observed prevalence of ever purchasing sex among men aged 18 to 45 years old who were accessible by landline telephone in 1999-2000 was similar to the lifetime prevalence found among non-institutionalized men at least 18 years old interviewed in-person as part of the 1998 General Social Survey.<sup>55</sup> Finally, it should be noted that this is a cross-sectional analyses, and the temporal sequence of purchasing sex in relation to other behavioral risks, history of STIs and current residence cannot be documented.

## **Conclusion**

Male clients of sex workers represent an important high-risk group that globally has not received the same level of research attention as sex workers themselves. Clients have the means to hire another person for sexual intercourse and to potentially purchase unprotected sexual acts that increase the risk of sexually transmitted infections. Clients merit further public health research to help guide more comprehensive prevention measures from multiple-levels to address clients' elevated risks of STI and HIV and subsequent potential infection spread between clients and their other sexual partners.

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**Table 3.1. Prevalence of U.S. males who ever have had sex with a sex worker (clients) by socio-demographic characteristics.**

	N	Prevalence [95% CI]	Unadjusted Prevalence Ratio [95% CI]
Total	469	14.5 [11.5-18.1]	NA
Age			
26 to 35	229	12.0 [8.3-16.9]	1
36 to 45	240	17.1 [12.6-22.7]	1.43 [0.90-2.27]
P value (P value for trend) <sup>a</sup>		0.129 (0.028 )	
Race/Ethnicity			
Non-Hispanic white	363	15.4 [11.9-19.7]	1
Non-Hispanic Black	32	7.7 [2.3-22.9]	0.50 [0.15-1.66]
Non-Hispanic other	30	7.2 [2.1-21.7]	0.47 [0.14-1.57]
Hispanic/Latino	40	22.4 [11.8-38.4]	1.46 [0.76-2.79]
P value		0.1949	
Current Marital Status			
Married/Cohabiting	320	13.3 [10.0-17.6]	1
Previously married	66	16.4 [8.6-29.0]	1.23 [0.62-2.42]
Never married	82	20.5 [12.6-31.5]	1.54 [0.89-2.64]
P value		0.3043	
Education Completed			
Bachelor or graduate degree	173	11.0 [7.1-16.6]	1
Some college or trade school	166	19.7 [14.2-26.7]	1.80 [1.05-3.06] *
High school or GED	96	13.0 [7.4-21.6]	1.18 [0.59-2.35]
Less than high school	34	12.4 [4.3-30.7]	1.13 [0.38-3.35]
P value		0.0809	

Notes: Abbreviations: CI, confidence interval; NA, not applicable. Significance level for comparison to reference group: ^<0.10, \*<0.05, \*\*<0.01, \*\*\*<0.001. N represents unweighted sample size. Weighted percentage reflects the representative proportion in the target US population. <sup>a</sup> Linear association between age in years and clients using univariate linear regression analysis.

**Table 3.2. Comparison of sexual risk behaviors, substance use, history of STIs and HIV screening between U.S. male clients and non-clients.**

	Clients Prevalence [95% CI] (N=75)	Non-Clients Prevalence [95% CI] (N=394)	Unadjusted Prevalence Ratio [95% CI]	Adjusted Prevalence Ratio [95% CI] <sup>a</sup>
<i>Sexual risk</i>				
Six or more lifetime sexual partners	81.0 [68.4-89.4]	45.7 [41.5-51.0]	4.13 [2.15-7.92] ***	3.97 [2.08-7.59] ***
Ever same-sex partners	17.8 [10.5-28.6]	6.1 [4.0-9.2]	2.55 [1.50-4.34] ***	2.48 [1.49-4.13] ***
Ever been paid for sex	16.5 [9.1-28.1]	2.3 [1.1-4.9]	4.34 [2.59-7.27] ***	3.64 [2.18-6.06] ***
One night stand in the past year	18.4 [10.9-29.3]	5.0 [3.2-7.5]	3.03 [1.85-4.96] ***	2.99 [1.84-4.86] ***
Multiple sexual partners in the past year	28.2 [19.1-39.7]	11.0 [8.1-14.8]	2.52 [1.59-3.99] ***	2.58 [1.65-4.03] ***
Unprotected sex in the past year <sup>c</sup>	79.3 [66.8-87.9]	92.6 [89.3-95.0]	0.39 [0.23-0.67] **	0.35 [0.20-0.60] ***
<i>Substance Use</i>				
Sex while inebriated in the past month	36.2 [25.6-48.3]	24.6 [20.2-29.6]	1.59 [1.00-2.53] *	1.57 [0.98-2.50] ^
Binge drinking in the past month	36.6 [26.2-48.6]	27.4 [23.0-32.3]	1.43 [0.91-2.26]	1.49 [0.95-2.33] ^
Marijuana in the past year	23.0 [14.6-34.1]	13.8 [10.3-18.2]	1.67 [1.00-2.79] ^	1.79 [1.06-3.04] *
Cocaine use in the past year	4.3 [1.5-11.6]	2.1 [1.1-4.1]	1.82 [0.70-4.71]	2.60 [0.95-7.09] ^
Ever cocaine use	54.1 [41.9-65.9]	22.0 [18.0-26.7]	3.24 [2.06-5.08] ***	3.18 [2.03-4.97] ***
Ever injected drugs	7.7 [3.5-16.2]	2.1 [1.2-4.1]	2.71 [1.34-5.35] **	2.06 [1.10-3.85] *
<i>STI/HIV Screening</i>				
Ever diagnosed with chlamydia or gonorrhea	18.8 [10.9-30.6]	5.2 [3.3-8.2]	2.97 [1.75-5.05] ***	2.54 [1.47-4.40] **
HIV test in the past year	26.2 [16.8-38.4]	18.5 [14.5-23.2]	1.46 [0.87-2.45]	1.50 [0.89-2.52]

Notes:

<sup>a</sup> Multivariate analyses adjusted for age in years and education completed. Prevalence ratio of clients reporting listed characteristic relative to clients not reporting the characteristic.

Significance level: ^ &lt;0.10, \* &lt;0.05, \*\* &lt;0.01, \*\*\* &lt;0.001.

Weighted percentage reflects the representative proportion in the target US population.

**Table 3.3. Prevalence of U.S. male clients by urbanization level of residence, all males and males reporting never having had sex with another male (heterosexuals).**

	All Males		Heterosexual Males	
	N	Prevalence [95% CI]	N	Prevalence [95% CI]
Total	469	14.5 [11.5-18.1]	424	13.0 [10.0-16.7]
Central Cities of MSAs $\geq 1$ million	133	15.6 [10.5-22.7]	115	12.2 [7.5-19.2]
Fringe Areas of MSAs $\geq 1$ million	114	15.3 [9.5-23.8]	103	14.7 [8.8-23.6]
MSAs of 50,000 to 999,999	154	12.7 [8.1-19.5]	144	12.1 [7.5-19.0]
Micropolitan	43	9.1 [3.5-21.5]	39	6.8 [2.3-18.0]
Non-Core	25	22.7 [9.9-43.9]	23	23.2 [9.7-46.0]
P value		0.5655		0.3973

Notes: N represents unweighted sample size. Weighted percentage reflects the representative proportion in the target US population.

**Table 3.4. Association between urbanization level of residence and male clients. Weighted Poisson regression analysis.**

	Unadjusted Prevalence Ratio [95% CI]	Adjusted for Demographics Prevalence Ratio [95% CI]	Adjusted for Demographics, Drug Use and STIs Prevalence Ratio [95% CI]
Central Cities of MSAs $\geq 1$ million	ref.	ref.	ref.
Fringe Areas of MSAs $\geq 1$ million	0.98 [0.54-1.79]	1.08 [0.59-1.98]	1.00 [0.58-1.74]
MSAs of 50,000 to 999,999	0.81 [0.45-1.46]	0.77 [0.43-1.38]	0.91 [0.51-1.61]
Micropolitan	0.58 [0.22-1.57]	0.55 [0.21-1.46]	0.63 [0.28-1.44]
Non-Core	1.45 [0.62-3.39]	1.33 [0.57-3.11]	2.13 [0.93-4.91] ^
Age in years		1.05 [1.01-1.09] *	1.04 [1.00-1.09] *
College education <sup>a</sup>		0.82 [0.43-1.55]	0.99 [0.53-1.86]
Some college or Trade school <sup>a</sup>		1.49 [0.84-2.64]	1.45 [0.82-2.57]
Ever cocaine/injection drug use			3.10 [1.92-5.01] ***
Ever chlamydia/gonorrhea			1.77 [1.06-2.96] *

Notes: Significance level: ^ <0.10, \* <0.05, \*\* <0.01, \*\*\* <0.001.

<sup>a</sup> Reference is high school/GED education or less.

**Table 3.5. Unweighted generalized estimating equations analyses of the relationship between urbanization level of residence and male clients, unadjusted and adjusted for county composition and individual characteristics.**

	Unadjusted PR [95% CI]	Adjusted for County Composition PR [95% CI]	Adjusted for County Composition & Participants' Demographics PR [95% CI]	Adjusted for County Composition & Participants' Demographics, Drug Use and STI History PR [95% CI]
Central Cities of MSAs ≥1 million	1.0	1.0	1.0	1.0
Fringe Areas of MSAs ≥ 1 million	0.78 [0.44-1.38]	0.95 [0.46-1.96]	0.97 [0.47-2.00]	0.92 [0.45-1.90]
MSAs of 50,000 to 999,999	0.68 [0.38-1.20]	0.98 [0.48-2.02]	0.94 [0.45-1.94]	1.09 [0.52-2.27]
Micropolitan	0.60 [0.25-1.45]	0.90 [0.31-2.58]	0.86 [0.31-2.36]	1.04 [0.42-2.56]
Non-Core	1.45 [0.71-2.98]	2.66 [0.96-7.39] ^	2.44 [0.86-6.97] ^	3.55 [1.26-9.98] *
<i>County Composition</i>				
Non-Hispanic Whites median age		1.10 [0.84-1.43]	1.05 [0.78-1.40]	1.02 [0.78-1.32]
Blacks/African Americans median age		0.96 [0.52-1.75]	1.04 [0.57-1.91]	1.00 [0.57-1.75]
Hispanics/Latinos median age		1.29 [0.85-1.95]	1.45 [0.96-2.18] ^	1.44 [0.93-2.22]
Black/African American Sex Ratio				
Quartile I : 28-83		1.0	1.0	1.0
Quartile II: 83-96		1.22 [0.71-2.09]	1.23 [0.70-2.14]	1.21 [0.71-2.06]
Quartile III: 96-132		1.44 [0.75-2.79]	1.49 [0.77-2.87]	1.56 [0.86-2.85]
Quartile IV: 131-525		1.75 [0.74-4.11]	1.65 [0.73-3.71]	1.64 [0.75-3.55]
Hispanic/Latino Sex Ratio				
Quartile I : 22-100		0.66 [0.35-1.23]	0.60 [0.33-1.11]	0.58 [0.32-1.06] ^
Quartile II: 100-116		1.0	1.0	1.0
Quartile III: 116-142		1.18 [0.70-1.99]	1.13 [0.68-1.88]	1.16 [0.70-1.90]
Quartile IV: 142-517		0.70 [0.34-1.44]	0.73 [0.35-1.53]	0.59 [0.28-1.24]
White Sex Ratio				
Quartile I : 81-98		1.34 [0.72-2.49]	1.53 [0.85-2.74]	1.56 [0.87-2.80]
Quartile II: 98-100		1.0	1.0	1.0
Quartile III: 100-103		0.95 [0.43-2.10]	1.02 [0.47-2.23]	1.01 [0.48-2.14]
Quartile IV: 103-167		1.20 [0.63-2.28]	1.22 [0.64-2.31]	1.22 [0.63-2.36]

**Table 3.5: Continued.**

	Unadjusted PR [95% CI]	Adjusted for County Composition PR [95% CI]	Adjusted for County Composition & Participants' Demographics PR [95% CI]	Adjusted for County Composition & Participants' Demographics, Drug Use and STI History PR [95% CI]
County's Racial Composition				
Multi-ethnic		1.64 [0.90-3.00]	1.63 [0.92-2.90] ^	1.76 [0.97-3.19] ^
Black/African American		1.46 [0.65-3.24]	1.49 [0.70-3.19]	1.62 [0.76-3.46]
White		1.0	1.0	1.0
Other races/ethnicities		1.0	1.0	1.0
Percent Foreign Born (natural log)		1.12 [0.82-1.54]	1.15 [0.84-1.58]	1.10 [0.81-1.49]
Percent Below Poverty Ratio (square root)		0.94 [0.65-1.37]	0.88 [0.60-1.30]	0.84 [0.57-1.22]
<i>Participant's Characteristics</i>				
Age in years			1.05 [1.01-1.09] *	1.05 [1.01-1.08] *
College education <sup>a</sup>			0.79 [0.44-1.40]	0.95 [0.53-1.71]
Some college or Trade school <sup>a</sup>			1.66 [0.98-2.82] ^	1.68 [1.00-2.84] ^
Ever cocaine/injection drug use				2.98 [1.96-4.54] ***
Ever chlamydia/gonorrhea				1.94 [1.21-3.10] **

Notes: Significance level: ^ <0.10, \* <0.05, \*\* <0.01, \*\*\* <0.001.

<sup>a</sup> Reference is high school/GED education or less.



## Appendix

**Table 3.A. Prevalence of U.S. heterosexual males who ever have had sex with a sex worker (clients) by socio-demographic characteristics.**

	N	Prevalence [95% CI]	Unadjusted Prevalence Ratio [95% CI]
Total	424	13.0 [10.0-16.7]	
Age			
26 to 35	209	10.9 [7.2-16.0]	1
36 to 45	215	15.2 [ 10.8-20.9]	1.40 [0.8-2.3]
P value (P value for trend) <sup>a</sup>		0.051	
Race/Ethnicity			
Non-Hispanic white	332	13.6 [10.2-18.0]	1
Non-Hispanic Black	27	4.5 [ 0.6-25.9]	0.33 [0.05-2.3]
Non-Hispanic other	28	7.4 [2.2-22.5]	0.55 [0.16-1.86]
Hispanic/Latino	34	23.3 [11.9-40.6]	1.71[0.86-3.40]
P value		0.147	
Current Marital Status			
Married/Cohabiting	303	11.9 [8.6-16.1]	1
Previously married	56	17.9 [9.1-32.2]	1.51 [0.74-3.07]
Never married	65	16.8 [9.1-29.1]	1.42 [0.73-2.76]
P value		0.364	
Education Completed			
Bachelor or graduate degree	158	10.0 [6.1-15.8]	1
Some college or trade school	147	17.6 [12.2-24.8]	1.77 [0.98-3.21] ^
High school or GED	85	11.0 [5.7-20.0]	1.10 [0.50-2.42]
Less than high school	34	12.4 [4.3-30.7]	1.24 [0.41-3.76]
P value		0.319	

Notes: Abbreviations: CI, confidence interval; NA, not applicable.

Significance level for comparison to reference group: ^ <0.10, \* <0.05, \*\* <0.01, \*\*\* <0.001.

N represents unweighted sample size. Weighted percentage reflects the representative proportion in the target US population.

<sup>a</sup> Linear association between age in years and clients using univariate linear regression analysis.

**Table 3.B. Comparison of sexual risk behaviors, substance use, history of STIs and HIV screening between U.S. heterosexual male clients and non-clients.**

	Clients Prevalence [95% CI] (N=75)	Non-Clients Prevalence [95% CI] (N=394)	Unadjusted Prevalence Ratio [95% CI]	Adjusted Prevalence Ratio [95% CI] <sup>a</sup>
<i>Sexual risk</i>				
Six or more lifetime sexual partners	81.0 [66.5-90.1]	44.5 [39.1-50.0]	4.37 [2.11-9.07] ***	4.23 [2.05-8.72] ***
Ever been paid for sex	12.4 [5.63-25.2]	2.2 [0.93-5.04]	3.89 [1.94-7.81] ***	3.17 [1.68-5.98] ***
One night stand in the past year	13.1 [6.49-24.7]	4.2 [2.60-6.72]	2.67 [1.39-5.13] **	2.87 [1.50-5.49] **
Multiple sexual partners in the past year	23.3 [14.3-35.6]	10.3 [7.40-14.2]	2.22 [1.28-3.86] **	2.37 [1.38-4.06] **
Unprotected sex in the past year <sup>c</sup>	83.5 [69.3-92.0]	93.4 [90.0-95.8]	0.43 [0.21-0.86] *	0.36 [0.18-0.74] **
<i>Substance Use</i>				
Sex while inebriated in the past month	37.1 [25.3-50.7]	25.1 [20.6-30.4]	1.62 [0.96-2.71] *	1.58 [0.94-2.65] ^
Binge drinking in the past month	36.2 [24.8-49.4]	26.8 [22.3-31.8]	1.46 [0.88-2.43]	1.51 [0.91-2.49]
Marijuana in the past year	19.5 [11.4-31.5]	13.4 [9.9-18.1]	1.46 [0.80-2.68]	1.62 [0.86-3.05]
Cocaine use in the past year	4.4 [1.36-13.4]	1.79 [0.82-3.85]	2.11 [0.73-6.14]	3.37 [1.09-10.4] *
Ever cocaine use	51.8 [38.4-65.0]	20.6 [16.5-25.3]	3.28 [1.99-5.41] ***	3.27 [1.99-5.40] ***
Ever injected drugs	5.4 [2.12-12.9]	1.29 [0.5-3.0]	3.06 [1.35-6.95] **	2.31 [1.01-5.30] *
<i>STI/HIV Screening</i>				
Ever diagnosed with chlamydia or gonorrhea	14.6 [7.0-28.1]	4.8 [2.8-7.8]	2.66 [1.32-5.33] **	2.23 [1.10-4.52] *
HIV test in the past year	27.2 [16.8-41.0]	18.1 [14.0-23.1]	1.56 [0.88-2.77]	1.63 [0.91-2.91] ^

Notes:

a Multivariate analyses adjusted for age in years and education completed. Prevalence ratio of clients reporting listed characteristic relative to clients not reporting the characteristic.

Significance level: ^ <0.10, \* <0.05, \*\* <0.01, \*\*\* <0.001.

Weighted percentage reflects the representative proportion in the target US population.

**Table 3.C. Association between urbanization level of residence and heterosexual male clients. Weighted Poisson regression analysis.**

	Unadjusted Prevalence Ratio [95% CI]	Adjusted for Demographics Prevalence Ratio [95% CI]	Adjusted for Demographics, Drug Use and STIs Prevalence Ratio [95% CI]
Central Cities of MSAs $\geq 1$ million	ref.	ref.	ref.
Fringe Areas of MSAs $\geq 1$ million	1.20 [0.61-2.38]	1.29 [0.65-2.57]	1.14 [0.60-2.14]
MSAs of 50,000 to 999,999	0.98 [0.51-1.92]	0.93 [0.48-1.82]	1.02 [0.53-1.98]
Micropolitan	0.55 [0.18-1.72]	0.53 [0.17-1.67]	0.64 [0.22-1.85]
Non-Core	1.90 [0.76-4.77]	1.75 [0.68-4.50]	2.71 [1.08-6.81] *
Age in years		1.05 [1.00-1.09] *	1.04 [1.00-1.10] ^
College education <sup>a</sup>		0.87 [0.43-1.77]	1.05 [0.52-2.11]
Some college or Trade school <sup>a</sup>		1.49 [0.80-2.80]	1.52 [0.81-2.87]
Ever cocaine/injection drug use			3.40 [2.01-5.72] ***
Ever chlamydia/gonorrhea			1.54 [0.83-2.85] *

Notes: Significance level: ^ <0.10, \* <0.05, \*\* <0.01, \*\*\* <0.001.

<sup>a</sup> Reference is high school/GED education or less.

## **Chapter 4**

### **Population change and male clients of sex workers in U.S. Metropolitan Areas**

## Abstract

Population change is the growth or decline in human population in a geographic area over time. Population change has been recognized as an important structural factor or amplifier for the spread of infectious diseases, but there are few studies examining the impact of population change on the risk or prevalence of sexually transmitted infections (STIs) and HIV. Men who buy sex from sex workers (clients) are at high-risk of STIs, and they may serve as a bridge to lower risk sexual partners. This study uses a national probability sample to examine the association between population changes in U.S. metropolitan counties and the prevalence of male clients. Population change was calculated from 1990 to 2000 U.S. censuses' household population counts, and measured both categorically and as a continuous variable. Prevalence ratios [PR] with 95% confidence intervals [CI] were estimated using Poisson regression for survey data. The sample of men aged 26 to 45 years old (N=385) was 73% non-Hispanic white, 66% were currently married and 39% had completed at least four years of college. The prevalence of clients for metropolitan men was 14.8% (95% CI, 11.5-18.9). We found that a 1% increase in the county decennial population change was associated with a 1.5% increase in clients (PR 1.015, 95% CI, 1.004-1.026). Clients were about two-fold more likely to reside in counties where the growth was from 13.2% to 24.9% or at least 25%, compared to counties with population growth less than 13.2%, the national average (PR 1.9, 95% CI, 1.0-3.4, and PR 2.0, 95% CI, 1.1-3.8). The findings support the conclusion that population change may be a useful geographical indicator for targeting interventions to reduce STI/HIV risk from transactional sex, perhaps through the social marketing of condoms and STI/HIV health services.

**Keywords:** population change, urbanization, transactional sex, clients of sex workers, sexual risk behavior, metropolitan areas, United States.

## Introduction

Population change is the growth or decline in human population in a geographic area over time. Most of the population in the United States resides in metropolitan areas,<sup>i</sup> and as hubs of commerce, metropolitan areas tend to grow faster than non-metropolitan areas.<sup>1</sup> Although population change is not uniform between or within metropolitan areas, an important factor of population change in the U.S. is

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<sup>i</sup> Metropolitan status is defined by the Office of Management and Budget and it encompasses the size and density of a population nucleus associated with a county or counties and the economic integration with contiguous counties as derived from the level of work commuting exchange.

migration.<sup>2,3</sup> Several factors tend to favor population growth to a municipality such as a higher distribution of college graduates, income, employment, industry mix, quality of housing, and predominant mode of transportation.<sup>4</sup> Population change may impact the socioeconomic characteristics of a geographic area. A higher level of human capital of the population such as higher levels of education and income may be more likely to attract additional workers to an area, help expand the labor market, and contribute to better resourced community institutions.<sup>3,5</sup> In contrast, the loss of human capital may hinder economic recovery and increase the incentive for depopulation.<sup>3,6</sup> As derived from the consequences of census undercount, depopulation and marginal changes in population can also have a negative impact to the funding of many municipal services to the residents of an area.<sup>7</sup>

Population change has a historic relationship with mortality rates, along with the recognition that population change is linked to changes in living conditions which may in turn impact health.<sup>8</sup> While in the mid-nineteen century, population growth was positively associated with mortality, in modern days, pre-mature all-cause mortality is inversely associated with population growth in developed countries.<sup>9-12</sup> Findings suggests that the population change and pre-mature mortality relationship may be closely linked to the economic deprivation of the area,<sup>9,11</sup> and a stronger relationship for population decline have been reported for deaths which tend to disproportionately affect populations living in disadvantaged environments such as violent deaths and alcohol-related mortality.<sup>11</sup>

Though population change has been recognized as an important structural factor or amplifier for the spread of infectious diseases, there are few studies examining population change on the risk or prevalence of sexually transmitted infections (STIs) and HIV.<sup>13,14</sup> Other structural-level factors related to depopulation have been examined in relation to spatial concentration of STI/HIV. Wallace<sup>15</sup> documented that the reduction in municipal fire services triggered the loss of homes and population in poor overcrowded minority neighborhoods of New York City, leaving behind abandoned or partially occupied buildings that could organize drug-related activity and high-risk behavior for the spread HIV at the onset of the HIV epidemic. With the introduction of crack-cocaine in the 1980s to many city neighborhoods across the U.S., abandoned housing occupied for drug-related activity were also often linked to the exchange of sex for money or drugs and increased risk of STIs and HIV.<sup>16</sup> Du *et al.*<sup>17</sup> showed that decennial (1990-

2000) population loss along with increases in levels of household poverty were significantly associated with increased gonorrhea rates at the census tract level.

Although reports on migrants have described an increased sexual risk to STI/HIV for migrants in U.S. destinations areas with employment potential,<sup>18-23</sup> population change in migrant studies have largely remained as unmeasured background information to the study setting. One such high-infection risk behavior in reports of international migrant men in the U.S has been the high levels of transactional sex found, resonant of reports from international settings indicating the potential infection spread associated with migrating men and the increase demand for sex services.<sup>24-31</sup>

In both the context of poor areas with increased levels of abandoned homes and in migrants to potential prospering employment areas, an increased risk in STI/HIV infection associated with transactional sex has been observed. Men who buy sex from sex workers (henceforth referred to as clients) may serve as a steady bridge of infection between sex workers and spouses or other low-risk sexual partners.<sup>32</sup> For heterosexually transmitted infections, the role of clients in infection spread is heightened because women in sex work tend to experience a disproportionately higher prevalence of STI/HIV infection than women in the general population.<sup>33-35</sup> The burden of infection may also be markedly higher among subgroups of sex workers such as those who also inject drugs, transgender women and men who have sex with men (MSM).<sup>36</sup> In surveys of the general population, clients were at least three times more likely to self-report history of STIs than never clients or non-recent clients,<sup>37-39</sup> and elevated prevalence of biomarkers for a number of STIs have been detected among clients of sex work in various settings.<sup>40-48</sup>

HIV acquisition and transmission is enhanced by the presence of STIs.<sup>49, 50</sup> Derived from convenience samples, clients of female sex workers from low HIV prevalence countries (<1%) have been found to have an HIV prevalence that is two to eighteen folds higher than the country-specific prevalence of infection in adults,<sup>40, 42-46, 51</sup> underscoring that clients are a subgroup in the population at higher risk of becoming exposed to HIV.<sup>36</sup> Clients in the general population in international settings, and among special populations (i.e. residents of high-risk HIV neighborhoods, migrants, public clinic patients, and drug users) in U.S. metropolitan settings, have been associated with other high infection-risk behaviors for acquiring and transmitting infection such as numerous partners, concurrent sexual partners, low condom use in some settings, and substance use.<sup>19, 20, 37-39, 52-54</sup>

The objective of this study was to examine the relationship between population relative change in metropolitan counties with male clients using census data matched with survey data. The term “relative” denotes that the difference in population size between two points in time accounts for the baseline population size when calculating population change.

## **Methods**

### Sources of Data

Individual survey data were taken from the National STD Behavioral Measurement Experiment (NSBME), a probability sample of U.S. English speaking adults aged 18 to 45 years old residing in households with a landline telephone surveyed on a wide range of STI-related risk behaviors. The NSBME was conducted from September 1999 to April 2000 and methods have been described previously.<sup>55</sup> Briefly, the NSBME used random digit dialed (RDD) sets of telephone numbers to include all 50 states and the District of Columbia. Telephone interviewers screened 86.5% of the 14,250 generated telephone numbers for residential status and eligible participants in the household. One eligible household member was randomly selected for participation in the survey (without substitution). Of the 2,183 eligible respondents found through RDD method, 1,543 (70.7%) adults were interviewed. Following screening, recruitment, and verbal consent into the study, participants were surveyed on their demographic characteristics and a range of STI/HIV risk behaviors. The NSBME was reviewed and approved by the Institutional Review Boards of RTI International and the University of Massachusetts-Boston.

Population county data was obtained from the 1990 and 2000 U.S. Census Summary Files.<sup>56, 57</sup> Metropolitan status of counties and county-equivalents were based on the 1990 National Center for Health Statistics (NCHS) Urban Rural Classification Scheme for Counties.<sup>58</sup> Both data sources were linked to the NSBME study by U.S. Federal Information Processing System (FIPS) codes.

### Study population

A total of 652 men were surveyed in the NSBME, of which 497 resided in metropolitan counties and reported ever having had sex. Of these 497 men, two were missing age and 15 were missing a response to the outcome of interest, sex with a sex worker. Due to the low occurrence of the outcome among men aged 18 to 25 years old, (n=2, N=95), the analytic sample consists of the remaining 385 men aged 26 to 45 years old.



## Measures

### *Population relative change*

Population relative change of the non-institutionalized population in counties was examined as a continuous measure and calculated for each county as follows:  $((\text{Population in 2000} - \text{Population in 1990}) \div \text{Population in 1990}) * 100$ . Population relative change was also examined categorically using the national average and the average growth by urbanization level to inform cut-offs and provide a period-contextual anchor for population change that occurred in the U.S. from 1990 to 2000. This was done because the national population growth in the 1990s was higher than the population growth observed between decennial censuses since the 1970s or the 2000 to 2010 decade, likely due to shifts in the job and housing market which may have influenced the volume of migration.<sup>1, 59</sup> Furthermore, pattern of population change has differed by the existing urbanization level (i.e. large central cities, fringe or suburban areas and smaller sized or newer metropolitan areas (MAs)).<sup>5</sup> National and urbanization level's average population relative change were derived from the sum of the county-level household population counts for 1990 and 2000 (excluding U.S. territories). Using the national average, population relative change was categorized into four levels: population loss or no change ( $\leq 0\%$ ); slow growth (0.1% to  $< 13.1\%$ ) for less than the national average of 13.1%; moderate growth (13.1% to 24.9%); and fast growth ( $\geq 25\%$ ). In reference to the urbanization level's average corresponding to the baseline period of population change, counties were categorized into population loss or marginal change ( $< 2\%$ ), growth of at least 2% but less than its urbanization level's average, and growth at or above urbanization level's average. This was done to distinguish for example that a 13% increase in population is a notable growth, but somewhat small if this county was part of fringe area of a major MA. During the 1990s, the average population growth was 11.1%, in central cities of MAs of at least one million people, 17.9% in fringe areas of large MAs, 14.8% in MAs of at least 250,000 but less than one million people, and 12.6% in MAs of at least 50,000 but less than 250,000 people.

This study examined population relative change at the county-level because, in contrast to census tracks, counties geographical boundaries are relatively stable over time,<sup>60</sup> and results may more easily inform policy and programs for STI/HIV at an administrative level for many jurisdictions across the country.

### Outcome and risk factors

The outcome variable, ever a client of a sex worker, was based on the response to the question “have you ever had sex with a prostitute, either female or male, or with someone you paid for sex?” The risk factors of interest to describe the men in this study included: demographic characteristics (i.e. age, race/ ethnicity, educational attainment and current marital status), other sexual risk behaviors, history of substance use and history of STI/HIV screening. Sexual risk were dichotomized into six or more lifetime sexual partners versus fewer, ever versus never male-to-male sexual activity, multiple (2 or more) partners in the past year versus fewer, and among men with at least one sexual partner in the past year, always used a condom versus less than always or never. Binge drinking was defined as five or more drinks within a couple of hours, in the past month. Last use of illicit substances was examined in the past year for marijuana, but ever use instead, for any form of cocaine and injection drug use, as recent use is less commonly observed in a sample of the general population. STI history was based on a positive response to “has a doctor or nurse ever told you that you have chlamydia or gonorrhea? Men who had previously reported to have never have heard of the infection are included as never having it. HIV screening was ascertained from specifically asking respondents about receiving a blood test for HIV from a doctor or other medical care provider in the past year.

### Statistical Analysis

We compared demographic, STI/HIV screening, sexual risk and substance use characteristics of the sample by population relative change for categorical variables, and between clients versus non-clients using design-based Pearson chi-square test. Survey-design bivariate linear regression was used to test the difference in mean age for categories of population change. Sampling weights were applied that adjust for unequal probabilities of selection and non-response by census estimates of population distribution by age, race, and sex <sup>61</sup>. Poisson regression analyses for survey data was used to examine the relationship for the three measures of population relative change and male clients, and calculate unadjusted prevalence ratio (PR), adjusted prevalence ratio (Adj. PR), and corresponding 95% confidence intervals (CI). <sup>62</sup> Multivariate Poisson regression analysis adjusted for age in years, educational attainment and a dichotomized composite for cocaine and injection drug use to account for possible differential opportunity in their lifespan to have bought sex and affiliation to drug-using social environment that may heighten

opportunity for transactional sex. The NSBME participants were interviewed using a telephone audio-CASI system or by a telephone interviewer. Men's responses obtained using the two different interview modes were combined as these did not differ for the reporting of sex with sex worker ( $p=0.654$ ). All analyses were conducted using Stata/SE 11.2 for windows.<sup>63</sup>

## Results

Roughly 13% of the metropolitan men resided in a county that had a negative or no population growth from 1990 to 2000, 39% resided in counties that grew below the national average and 19% resided in a county that increased its 1990 population by at least one-fourth. Table 4.1 presents demographic, STI/HIV screening and behavioral characteristics of the study population by four levels of population relative change: loss or no change,  $\leq 0\%$ ; slow growth,  $0.1\%$  to  $<13.1\%$ ; moderate growth,  $13.1\%$  to  $24.9\%$ ; and fast growth,  $\geq 25\%$ . Overall, men had a mean age of 36 years, 73% were non-Hispanic white, 66% were currently married, 39% had completed at least four years of college, and 7% reported ever having had a gonorrhea or chlamydial infection. A higher proportion of men who had completed only some college or trade school resided in counties that loss population, but this difference failed to reach statistical significance. For the most part, men residing among the four groups of population relative change had minimal differences between them in STI/HIV screening and behavioral characteristics. Men residing in fast growing counties were on average slightly younger and had more lifetime sexual partners compared to men residing in counties that had a decade of negative, slow or moderate population growth ( $p<0.05$ ).

Table 4.2 displays the association of clients with history of STI/HIV screening and behavioral risk characteristics. The prevalence of metropolitan men who had ever bought sex was 14.8% (95% Confidence Interval [CI], 11.5-18.9%). Compared to men who had never bought sex, clients had a three-fold higher history of STIs ( $p<0.001$ ), and were at least two-folds more likely to have had a higher number of sexual partners in their lifetime ( $p<0.001$ ), in the past year ( $p<0.001$ ), and to have consumed harder drugs (cocaine,  $p<0.001$ ; injection drug use,  $p=0.079$ ). Clients, however, were more likely than non-clients to report always having had protected sex in the past year ( $p<0.05$ ).

The prevalence of clients significantly differed by category of population relative change ( $p<0.05$ ) (Table 4.3). The highest prevalence of clients was observed among men residing in counties that grew

moderately (20.0%, 95% CI, 13.0-29.4) and grew fast (21.4, 95% CI, 13.5%-32.3%) above the national average, or grew at or above the urbanization level's average (20.9%, 95% CI, 15.1-27.8). Table 4.4 presents the results from bivariate and multivariate regression analyses for the relationship between population relative change and clients. Using a continuous measure for population relative change, for every 1% increase in the county population over the decade, we found a 1.5% increase in male clients ( $p=0.006$ ). When population change was measured categorically, men residing in counties that grew moderately or grew fast above the national average for the decade were about two-folds more likely to have been clients than men residing in counties that grew below the national average (Prevalence Ratio [PR] 1.9, 95% CI, 1.0-3.4,  $p=0.047$ ; and PR 2.0, 95% CI, 1.1-3.8,  $p=0.033$ ). Clients were no more likely to reside in counties that lost or marginally changed population size versus counties that grew slowly, below average. The associations between population growth and clients persisted after adjusting for demographic characteristics and history of drug use for the continuous measure of population change (Adj. PR, 1.013, 95% CI 1.001-1.024,  $p=0.027$ ), and categorical measures in reference to the national average (moderate growth: Adj. PR, 2.1, 95% CI 1.2-3.7,  $p=0.010$ ) and in reference to the urbanization level average (Adj. PR, 1.7, 95% CI, 1.0-2.8,  $p=0.043$ ). In addition to adjusting the regression models for the demographic characteristics of age and education, the inclusion of demographic characteristics for marital status and race/ethnicity did not change the results.

## Discussion

We found a positive association between relative population change and the prevalence of men who have bought sex from a sex worker in a U.S. national random sample of adult men. The findings indicate that one-in-five men residing in metropolitan counties that had an increase in residents at or above the national overall rate of growth (moderate or fast) had bought sex, compared to about one-in-ten men residing in counties with lower levels of population change. These results show that the pace of urbanization in counties that are already part of established metropolitan areas in the U.S. impacts the distribution of male clients. To our knowledge, this is one of the first studies to directly examine the relationship between population change and the prevalence of male clients, two important influences on the transmission of STI/HIV<sup>13</sup>.

Purchasing sex was associated with an elevated history of STIs, partner turnover, and use of harder drugs, all of which may indirectly increase sexual risk or directly increase the risk of HIV. This result is consistent with previous reports in international samples indicating that clients have a high prevalence of STI history which may also be due to other parallel high-risk behaviors.<sup>37, 38</sup> These results support the inference that clients may represent a key high-risk subgroup for infection spread.<sup>32</sup> Overall, there were negligible differences in demographics, STI history and behavioral risk factors between the men residing in counties with a varying pace of population change. This suggests that the association between population change and the prevalence of clients was less likely due to differences in the measured individual-level characteristics of men residing in counties with different rates of population change. In multivariate analysis, adjustment for demographic characteristics and history of drug use factors deemed most relevant to the uneven distribution of men with history of buying sex made a minimal difference in the relationship between population growth and clients.

A plausible mechanism for the positive association between urbanization and buying sex may be provided by social network theories. In the theoretical framework called ‘community liberated’, Wellman<sup>64</sup> posits that the separation of work, residence, and kin relationships, as a result of urbanization, facilitated the development of social ties by setting and relationship type. Consequently, urbanization may shape social networks so that individuals may become part of multiple weakly connected social networks in which members need not be spatially bounded. Several factors can contribute to this process: (1) high mobility of the population delaying the formation of locally based strong ties; (2) communication and transportation resources enabling the maintenance of important spatially dispersed ties; (3) spatially dispersed primary ties that increases the likelihood of forming social ties with others who also have spatially dispersed primary ties; and (4) the widespread distribution of venues for social interaction in urbanized areas which increases the opportunity to access diverse, loosely connected, social networks.

However, when it comes to sexual relationships, sexual behavior is spatially bounded.<sup>65-67</sup> Laumann and colleagues’ theory of sex markets<sup>68</sup> postulates that the geographic space that contains the settings for meeting different types of sexual partners (i.e. exchange, long term, casual) physically bounds sexual behavior. These settings have sexual cultures that provide criteria for organizing sexual partnering (e.g., visual cues of the sexual orientation of venues, information about the prospect and acceptability of

meeting a casual sex partner, beliefs about paid partners, etc.). Multiple and more weakly connected social network memberships may increase opportunities and provide more informational resources about different types of sexual partnerships. Such networks may reduce the influence of strong social network members such as parents or close friends. These members may exercise control over sexual partnerships by acting as stakeholders, promoting or discouraging some types of sexual behavior and partnerships. An individual's degree of embeddedness in a social network, sexual culture and to a lesser extent, institutions (e.g., religion, workplace) narrows sexual choices and pushes individuals toward choosing particular sexual partners and engaging in particular HIV risk behaviors.

Rapid urbanization may diminish the number of stakeholders. Locales experiencing population growth may have a greater proportion of its residents without locally-bounded primary ties who may act as stakeholders within the local context where sexual partnering occurs. Oliver<sup>69</sup> observed a lack of kin, co-members of organizations, and co-workers living in the same neighborhood among African Americans living in a suburban neighborhood where African Americans were mainly recent arrivals<sup>69</sup>. Family and close friends who are physically remote may have reduced influence to competently guide sexual partnering and discourage partners of high HIV risk.<sup>70</sup>

Mahay and Laumann<sup>70</sup> have reported that heterosexual men living in an area with few long-term residents or relatives living in the same city were less likely to share mutual friends with their last sex partner. They also were less likely to have a relative who knew their last sex partner than men living in an area with more population permanency and a strong family presence in the same city. Furthermore, findings from Latkin and colleagues<sup>52</sup> support the role of family in inhibiting high HIV risk partnerships. Urban men who had bought sex had personal networks with fewer kin members than men who had not bought sex. A geographic area with rapid urbanization where residents are devoid of locally-bounded stakeholders may also shape a sexual culture that better organizes casual and transactional sexual relations than long-term relationships.<sup>68</sup>

Globally, there has been a steady growth of population residing in urbanized areas.<sup>71</sup> At the turn of the twentieth century, 28% of the U.S. population resided in metropolitan areas, today more than four-fifths (83%) of the U.S. population resides in metropolitan areas.<sup>72</sup> More people reside in the suburbs or fringe areas outside major cities as modern-day metropolitan areas have become decentralized in terms of

employment opportunities.<sup>73, 74</sup> While central cities remain an important economic core, in recent decades, suburban jurisdictions have been competing to meet the demand for greenfield developments with office parks and large houses providing low residential density for populations with high incomes.<sup>75</sup> Automobile technology has facilitated commuting within metropolitan areas, and it has also contributed to population growth in the outer fringe counties with attractive natural amenities including an appealing environment and proximity to jobs.<sup>76</sup>

Urbanization of the outer fringe areas, however, may contribute to disinvestment in the rest of the metropolitan area. Suburban jurisdictions closer to the central city that were once vital centers of manufacturing activity are now struggling to attract new investments in the built environment.<sup>75</sup> Housing costs and high property taxes block lower income racial and ethnic minorities from living in well-resourced neighborhoods thereby hindering social mobility.<sup>77, 78</sup> Suburban minority neighborhoods offer fewer and lower paying jobs than non-minority suburban neighborhoods, thus generate lower tax returns for funding local institutions and infrastructure.<sup>79, 80</sup> As such, urbanization is a social determinant of health because of its differential impact on living conditions which in turn affects health outcomes.<sup>81</sup> Findings from this study indicate that rapid urbanization is associated with a higher prevalence of men buying sex and increased potential for the spread of STI/HIV.

Individuals in high-poverty areas have a higher risk of STI/HIV infection<sup>82-85</sup> and as previously described, neighborhoods experiencing population loss seem to have a higher burden of infection.<sup>15, 17</sup> We found that clients were as likely to reside in counties that lost population as in counties of slow population growth versus faster growth. While clients' high behavioral risk profile may facilitate infection spread to low-risk populations, future studies could provide a better understanding of the role that clients play in the geographical spread of infection from high-infection areas to low-infection areas in the U.S. This should include expansion of ecological studies mapping the spread of diagnosed cases over time and geographical space.<sup>86, 87</sup>

Population relative change was also examined in relation to cut-offs for the national average and urbanization level's average. This was done to provide a contemporaneous marker for economic opportunities and infrastructure developments while also recognizing that the magnitude of population growth may depend on the existing size of the economic area (i.e. the metropolitan area).<sup>88, 89</sup> While this

categorization approach may limit compatibility to other periods and places, there is no standard for categorizing population change. Limited consistency and few justifications for the categorization cut-offs of population change used have been offered in reports for descriptive purposes or on its relation to health outcomes.

### Limitations

The foregoing findings should be viewed in light of several limitations. Several measures pertinent to the buying of sex were not collected including; condom use for paid sex, gender of the sex worker, how long ago and location relative to the current county of residence. An additional analysis restricted to men who reported never having same-sex partners did not change our main results. The low prevalence of ever having bought sex among adults aged 18 to 25 years old in the NSBME, and among young males in two contemporaneous national surveys<sup>90, 91</sup> suggests that this high-risk sexual behavior in the U.S. may more commonly commence during the ages included in our study sample.

Self-reported chlamydial and gonorrhea infection were the only STIs measured in the NSBME, thus limiting our understanding of clients' infection. These STIs are less common among men aged 26 to 45 years than among younger men, and it is possible that men may have not remembered or underreported ever having these infections. Furthermore, gonorrhea and chlamydia are commonly asymptomatic, and men may have been unaware of their infection status. We also could not examine clients in relation to their history of migration because these measures were not available in the survey. In addition, the prevalence of male clients at the baseline period of population change is not known. There is some suggesting evidence that men buying sex from sex workers may have increased. Findings from the National Survey of Sexual Attitudes and Lifestyles for 1990 and 2000 in Britain suggest that more men in the general population may be buying sex.<sup>38</sup> An increase in transactional sex is plausible for the U.S. as some argue that in recent years adult entertainment venues (i.e. strip clubs, lap dance clubs, massage parlor), where sex may sometimes be illicitly bought, have become more mainstream within the urban economy and marketable as another outlet of consumption for men in developed countries with a consumer-based economy.<sup>92, 93</sup> Finally, it should be noted that post-stratification sampling weights were applied to adjust for non-response and underrepresentation of key demographic groups. Nonetheless, telephone surveys still may underrepresent



responses from men living alone or with roommates, in poverty, and ethnic/racial minorities because these groups are less likely to live in households with telephone service.<sup>94</sup>

### Conclusion

Our findings indicate that population change is positively associated with STI/HIV risks from transactional sex among men in U.S. metropolitan areas. There are challenges in identifying specific venues associated with transactional sex which may be subsequently linked to a rise in STI or HIV diagnoses. The findings of this study support the notion that population change may be an important geographical indicator of STI/HIV risk from transactional sex. This may assist in targeting interventions such as social marketing of condoms and STI/HIV health services targeting adult men, specifically clients. While such wide-range audience efforts may be better contextualized in relevance to the local STI-HIV epidemic, more research is needed to assess the local extent of clients demand for unprotected paid sex and for hindering safe-sex practices with sex workers. Geographical variation in the disclosure of HIV status on online dating websites has been reported<sup>95</sup> which suggest that social norms about perceived infection risk may be locally determined. The increased prevalence of male clients found in metropolitan counties with moderate and fast population growth, relative to other counties, raises concern that paid sex in economically prospering environments may be more likely construed as normative and of inconsequential sexual risk.

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**Table 4.1. Characteristics of metropolitan men by the 1990-2000 population relative change in the county of residence.**

	<b>Total</b>	<b>Loss or No Change (≤ 0%)</b>	<b>Slow Growth (0.1% to &lt;13.1%)</b>	<b>Moderate Growth (13.1% to 24.9%)</b>	<b>Fast Growth (≥ 25%)</b>	
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	p value
unweighted sample size	N=385	N=49	N=154	N=106	N=76	
Total %		13.3	38.8	29.3	18.6	
<u>Demographic Characteristics</u>						
Mean age in years (95% CI)	35.8 (35.1-36.4)	36.5 (34.7-38.3)	36.4 (35.4-37.4)	35.2 (34.0-36.4)	34.8 (33.6-35.9)	>0.04 <sup>a</sup>
Non-Hispanic White	73.1 (67.6-77.9)	67.4 (50.4-80.7)	69.9 (60.9-77.6)	71.6 (61.1-80.3)	85.9 (74.8-92.6)	0.117
Current Marital Status						
Married	65.9 (60.6-70.8)	62.1 (46.6-75.5)	58.6 (49.8-66.8)	74.7 (65.0-82.4)	69.9 (58.7-79.1)	0.364
Cohabiting unmarried	11.3 (8.0-15.8)	15.3 (6.1-33.7)	12.4 (7.2-20.5)	9.3 (4.6-17.8)	9.2 (4.4-18.5)	
Previously married	9.4 (6.8-13.0)	7.1 (2.7-17.1)	11.5 (6.9-18.6)	6.3 (2.8-13.6)	11.7 (6.4-20.2)	
Never married	13.4 (10.4-17.0)	15.4 (8.3-27.0)	17.5 (12.3-24.3)	9.7 (5.5-16.6)	9.2 (4.7-17.4)	
Education Completed						
High School or less	29.0 (24.2-34.3)	26.9 (15.5-42.4)	33.7 (25.7-42.8)	26.4 (18.3-36.6)	24.7 (16.0-36.0)	0.107
Some college or trade school	32.4 (27.7-37.6)	49.0 (34.4-63.8)	26.8 (20.1-34.7)	29.6 (21.3-39.4)	36.9 (26.3-48.9)	
Bachelor or graduate degree	38.6 (33.5-43.8)	24.1 (13.6-39.1)	39.5 (31.5-48.0)	44.0 (34.4-54.1)	38.4 (27.8-50.3)	
<u>STI/HIV Screening</u>						
Ever gonorrhea or chlamydia	6.9 (4.6-10.3)	11.2 (3.9-28.1)	7.4 (4.0-13.2)	3.9 (1.4-10.6)	7.4 (3.4-15.6)	0.469
HIV test in the past year	20.3 (16.2-25.1)	20.1 [10.3-35.6]	16.6 (10.9-24.5)	21.4 [14.3-30.7]	26.5 (17.1-38.5)	0.485
<u>Sexual risk</u>						
Six or more lifetime sexual partners	52.3 (46.9-57.7)	42.9 (29.2-57.7)	50.9 (42.3-59.5)	44.8 (35.1-54.9)	73.7 (62.1-82.8)	0.002
Ever same-sex partners	7.8 (5.4-11.0)	9.8 [4.3-20.9]	6.1 (3.0-12.1)	5.6 (2.6-11.5)	13.3 (7.2-23.3)	0.203
Multiple partners in the past year	12.5 (9.6-16.2)	7.7 (3.0-18.2)	13.3 (8.8-19.6)	11.8 (7.0-19.2)	15.4 (8.8-25.6)	0.604
Always condom in the past year	9.3 (6.6-12.9)	8.3 (3.1-20.4)	6.9 (3.9-12.0)	14.6 (8.6-23.5)	6.4 (2.5-15.4)	0.164

**Table 4.1: Continued.**

	<b>Total</b>	<b>Loss or No Change (≤ 0%)</b>	<b>Slow Growth (0.1% to &lt;13.1%)</b>	<b>Moderate Growth (13.1% to 24.9%)</b>	<b>Fast Growth (≥ 25%)</b>	
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	p value
unweighted sample size	N=385	N=49	N=154	N=106	N=76	
Total %		13.3	38.8	29.3	18.6	
<i><u>Substance Use</u></i>						
Binge drinking in the past month	28.9 (24.4-33.9)	26.9 (15.7-42.1)	28.2 (21.4-36.3)	23.1 (15.9-32.4)	40.6 (29.7-52.5)	0.113
Marijuana in the past year	14.1 (10.7-18.3)	12.6 (5.9-25.1)	17.3 (11.6-25.0)	8.1 (3.8-16.4)	17.7 (10.5-28.3)	0.198
Ever any form of cocaine	28.6 (24.0-33.6)	18.5 (9.9-32.0)	32.3 (24.8-40.9)	23.9 (16.2-33.7)	35.4 (25.3-47.1)	0.122
Ever injected drugs	3.0 (1.7-5.1)	2.2 (0.3-14.0)	2.1 (0.9-4.6)	3.4 (1.2-9.1)	4.7 (1.5-13.6)	0.699

<sup>a</sup>Linear regression of age with men residing in counties of slow growth as a reference to those in counties with population loss (p=0.966), moderate growth (p=0.131) or fast growth (p=0.036).

**Table 4.2. Prevalence of clients, and bivariate association of STI/HIV screening and behavioral risk factors of male clients versus never clients in metropolitan areas.**

	Prevalence (95% CI)	Unadjusted PR (95% CI)	p value
Total	14.8 (11.5-18.9)	—	—
<i>STI/HIV Screening</i>			
Ever diagnosed with chlamydia or gonorrhea	18.1 (9.6-31.3)	3.0 (1.6-5.4)	p<0.001
HIV test in the past year	23.8 (14.3-36.9)	1.2 (0.7-2.2)	p=0.491
<i>Sexual risk</i>			
Six or more lifetime sexual partners	80.2 (66.4-89.3)	3.7 (1.9-7.3)	p<0.001
Ever same-sex partners	16.8 (9.2-28.8)	2.4 (1.3-4.3)	p=0.006
Multiple sexual partners in the past year	25.9 (16.3-38.5)	2.4 (1.5-4.0)	p=0.001
Always condom use in the past year	17.3 (9.2-30.2)	2.0 (1.1-3.8)	p=0.031
<i>Substance Use</i>			
Binge drinking in the past month	36.2 (24.8-49.4)	1.4 (0.8-2.3)	p=0.194
Marijuana in the past year	21.2 (12.5-33.6)	1.6 (0.9-2.9)	p=0.100
Ever cocaine use	55.0 (41.6-67.7)	3.0 (1.9-5.0)	p<0.001
Ever injected drugs	6.4 (2.5-15.4)	2.2 (1.0-5.1)	p=0.079

Notes: PR, prevalence ratio, CI, confidence interval.

**Table 4.3. Estimated prevalence of metropolitan male clients by the 1990-2000 population relative change in county of residence.**

County of Residence	N	Prevalence	
		% (95% CI)	p value
In Relation to National Average			
Loss or no change ( $\leq 0\%$ )	49	6.0 (1.9-17.2)	0.023
Grew less than national average (0.1% to $<13.1\%$ )	154	10.7 (6.7-16.8)	
Grew moderately at or above national average (13.1% to $24.9\%$ )	106	20.0 (13.0-29.4)	
Grew rapidly above national average ( $\geq 25\%$ )	76	21.4 (13.5-32.3)	
In Relation to Urbanization Level			
Loss or marginal change ( $<2\%$ )	63	4.6 (1.5-13.5)	0.005
Grew at least 2% but less than urbanization level's average	146	12.2 (7.7-18.7)	
Grew at or above urbanization level's average	176	20.8 (15.1-27.8)	

**Table 4.4. Association of population relative change in county of residence with male clients using Poisson regression analysis.**

	N	Unadjusted PR		Adjusted PR	
		(95% CI)	p value	(95% CI)	p value
County's Population Relative Change (continuous)	385	1.015 (1.004-1.026)	0.006	1.013 (1.001-1.024)	0.027
In Relation to National Average (categorical)					
Loss or no change ( $\leq 0\%$ )	49	0.559 (0.169-1.852)	0.341	0.599 (0.177-2.023)	0.409
Grew less than national average (0.1%-13.1%)	154	1		1	
Grew moderately at or above national average (13.2%-24.9%)	106	1.864 (1.008-3.446)	0.047	2.117 (1.195-3.749)	0.010
Grew rapidly above national average ( $\geq 25\%$ )	76	2.000 (1.059-3.768)	0.033	1.830 (0.992-3.375)	0.053
In Relation to Urbanization Level's Average (categorical)					
Loss or marginal change ( $< 2\%$ )	63	0.379 (0.114-1.257)	0.113	0.384 (0.115-1.284)	0.120
Grew at least 2% but less than urbanization level's average	146	1		1	
Grew at or above urbanization level's average	176	1.702 (0.994-2.916)	0.053	1.678 (1.015-2.772)	0.043

Note: Multivariate analyses adjusted for age, education, and history of injection drug or cocaine use.

## **Chapter 5**

### **Population growth in U.S. metropolitan areas and male clients of sex workers**

## **Abstract**

Male clients of sex workers are at high-risk of acquiring and transmitting sexually transmitted infections (STIs) including HIV. Population increase in a metropolitan area reflects a region with favorable economic conditions to retain population and attract populations from other areas, but population increases may not be equivalent within its subdivisions. There is a dearth of empirical work on the relationship between population increases and the prevalence of male clients. We examined county-level population increases with male clients in metropolitan areas using a national random sample of U.S. men aged 26-45 years old (N=303). We calculated whether a county increased population at a slower, similar or faster rate than its metropolitan region using 1990 and 2000 population census counts. Generalized estimated equation regression was used to examine the association between types of population increase and clients. Multivariate analysis adjusted for individual characteristics and county-level demographic composition. In overall, 17.5% of men residing in metropolitan counties that had a population increase reported ever having paid for sex ("clients"). A higher prevalence of clients resided in counties with a similar or a fast population increase for its region versus a slow increase, but this difference failed to reach statistical significance in bivariate analysis. In multivariate analysis that adjusted for county-level compositional differences, clients were about two-folds more likely to reside in counties that had a population increase that was similar to its region or fast for its region, versus a slow population increase for its region (Adjusted Prevalence Ratio [PR]: 2.4, 95% confidence interval [CI]: 1.1-5.3,  $p<0.05$ ; and Adj. PR: 2.5, 95% CI: 1.1-5.9,  $p<0.05$ , respectively). The findings suggest that population increases within metropolitan areas may help identify areas that may be more vulnerable to the spread of STI/HIV associated with transactional sex.

**Keywords:** urbanization, human population increase, metropolitan areas, United States, male clients, transactional sex, sexual behaviors, HIV risks.

## **Introduction**

Population increase is the total population added in a given period of time resulting from natural increase and migration.<sup>1</sup> In the United States, migration plays a predominant role in population increase as birth and death rates are relatively stable.<sup>2,3</sup> In contrast to population loss, population increase (also termed population growth) in a city or municipality is viewed as economically more favorable because it reflects that the area is retaining population and attracting populations from other areas.<sup>4</sup> Migration flows are not

random, but tend to be influenced by the rewards offered for the skills in a geographic region.<sup>2</sup>

Metropolitan areas can represent an important geographical boundary containing the unique regional economic conditions and infrastructure to attract (or deter) population increase, such as industry mix and development, and transportation hubs.<sup>5</sup> However, metropolitan areas are commonly comprised of multiple municipalities that may not have an equivalent appeal to retain or attract residents. In general, factors associated with population growth in U.S. cities include a higher distribution of college graduates and household incomes, and a lower proportion of unemployment and poverty.<sup>6</sup> Within metropolitan areas, places that gain more population have different socio-economic and built environments than the places that gain less population. Characteristics of places outperforming the population growth within their own metropolitan area include having more residents with higher income, more newly built housing and more out-of-state born residents; correspondingly, characteristics of places underperforming the population increase within their own metropolitan area include having a lower median household income, older housing, and fewer owner-occupiers.<sup>7</sup>

In international settings, migration of working-aged men for work has been associated with high sexual risk behavior, including unprotected sex with sex workers, and the spread of sexually transmitted infections including HIV (STI/HIV) at destination areas, hometowns and along major travel routes.<sup>8-15</sup> Reports of Latin American migrant men in non-traditional immigrant gateway areas in the U.S. also indicate an elevated prevalence of risk factors for STI/HIV, including frequent visits to sex workers.<sup>16-18</sup>

Across numerous settings, transactional sex plays an important role in STI and HIV transmission.<sup>19-25</sup> While globally there are few published reports on men who buy sex from sex workers (henceforth referred to as “clients”), these consistently indicate that clients have an increased burden of STI/HIV.<sup>24, 26-38</sup> Clients were at least three to ten times more likely to self-report a history of STIs than never clients or non-recent clients among men surveyed in nationally representative studies of the population in Australia, Britain, and China, as well as in a general clinic-based sample in the United States;<sup>28-30, 34</sup> Derived from convenience samples in studies that offered HIV testing conducted in low HIV prevalence countries (<1%), including the U.S., clients of female sex workers were found to have a HIV prevalence that was two to eighteen folds higher than the country-specific HIV prevalence in adults.<sup>27, 33, 35-39</sup> Men who have purchased sex have also been associated with other factors that increase the risk of



acquiring and spreading infection between sexual partners, including substance use and numerous partners in a short period of time.<sup>26, 28, 29, 34, 40, 41</sup> Although prevalence of unprotected paid sex in the U.S. has varied across population studied and sexual act bought, findings from a clinic-based sample found that roughly two-fifths of clients (39%) reported to have persuaded a woman into having unprotected sex in the past year compared to 5% of men who had not paid for sex in the past year.<sup>16, 17, 34, 40, 41</sup> These findings stress the potential role clients as a key group in the spread of infection in the population.

There is a dearth of empirical work on the relationship between the magnitude population increase to an area and male clients. Using a national random sample, we examined the association between county-level population increases with male clients in metropolitan areas. We focus on metropolitan areas because these tend to be centers for commerce which have historically had a faster population growth than non-metropolitan counties.<sup>42</sup> Population increase in counties is quantified in relation to regional population change, and not the actual percentage increase, because the rate of population growth is not equally distributed across the country.<sup>43</sup> As such, the same percentage population growth may reflect a slow increase for its region but a fast increase in another when compared to its own region. The metropolitan area may give a regional gauge for defining a high-volume or weak population growth in one of its counties as population changes may be more closely link to the overall regional employment and housing dynamics.<sup>5, 42</sup> We examined population growth in counties because their geographical boundaries are relatively stable over time and results may more easily inform STI/HIV policy and programs at an administrative level for many jurisdictions across the country.

## **Methods**

Individual survey data were taken from the National STD Behavioral Measurement Experiment (NSBME), a probability sample of English speaking men and women aged 18 to 45 years old residing in U.S. households with a working landline telephone. The NSBME was conducted from September 1999 to April 2000 and methods have been described previously.<sup>44</sup> Briefly, the NSBME used random digit dialed (RDD) sets of telephone numbers to include all 50 states and the District of Columbia. Telephone interviewers screened 86.5% of the 14,250 generated telephone numbers for residential status and eligible participants in the household. If more than one eligible member was found per household, one was randomly selected for participation. Of the 2,183 eligible respondents per household found through RDD,

1,543 (70.7%) adults were interviewed. The NSBME was reviewed and approved by the Institutional Review Boards of RTI International and the University of Massachusetts-Boston.

#### *Outcome Measure and Individual Characteristics*

The behavioral outcome, client of a sex worker (referred to as “clients”), was derived from men who answered yes to the question “have you ever had sex with a prostitute, either female or male, or with someone you paid for sex?” Individual characteristics of interest captured through the interview were general demographics (i.e. age, education, marital status and race/ethnicity), history of STIs, HIV-testing, and substance use. History of STIs was based on a positive response to separate questions that asked whether they had ever been told by a doctor or nurse to have gonorrhea or chlamydia. Men who had previously reported never having heard of the infection were categorized as never having it. HIV-screening was limited to the past year, and it specifically asked whether they had received from a doctor or other medical care provider a blood test for HIV. Substance use was included with the goal of understanding men’s potential link to high-risk infection contexts. Alcohol use was specific to binge drinking (defined as five or more drinks within a couple of hour),<sup>45</sup> and sex while feeling the effects of alcohol, in the past month. We examined marijuana use in the past year, and ever lifetime use of any form of cocaine and drug injection as these harder drugs are less frequently reported in the general population. A dichotomous composite of ever cocaine or injection drug use was also created.

#### *County Population Growth in Relation to their Metropolitan Area*

Population counts for non-institutionalized population at the county level were obtained using the 1990 and 2000 U.S. Census, Summary File 1 (SF-1).<sup>46, 47</sup> Counties were classified into their respective metropolitan area according to the 1993 Office of Management and Budget definitions for Consolidated Metropolitan Statistical Areas (CSMAs) or Metropolitan Statistical Areas (MSAs) and New England County Metropolitan Areas (NECMA).<sup>48</sup> CSMAs/MSAs and NECMAs are henceforth referred to as metropolitan areas (MAs). The total household population in each MA for 1990 and 2000 was calculated by adding the household population of all its component counties. MAs consisting of a single county were excluded.

The location quotient (LQ) measure was used to quantify county population growth relative to its share in the metropolitan area.<sup>49</sup> LQ results in a numerical equivalent for whether the county’s population

in the year 2000 had decreased, retained or increased its share of the total MA population from what it was in 1990. The LQ for county  $i$  in MA  $k$  was calculated as follows:

$$LQ = \frac{(\text{Population}_{ik\ 2000} / \text{Population}_{k\ 2000})}{(\text{Population}_{ik\ 1990} / \text{Population}_{k\ 1990})}$$

LQ results were divided into third tile corresponding to three priori results: 1) county grew at a slower rate than its overall MA (LQ values <1.0); 2) county grew at a similar rate than its overall MA (LQ values  $\approx$  1.0); and 3) county grew at a faster rate than its overall MA (LQ values >1.0). Specifically, the three types of population growth relative to the MA resulted in LQ values with a median and interquartile range (IQR) of 0.957 (IQR 0.925 and 0.957) for a slower rate of growth, 1.012 (IQR 0.999 and 1.026) for a similar growth, and 1.12 (IQR 1.071 and 1.20) for a faster growth. Counties that grew at a faster speed than their MA were less populated and part of a larger metropolitan area than counties with a slower speed of growth. Table 5.1 describes population size and population change corresponding to U.S. metropolitan counties that increased population from 1990 to 2000.

#### County-level Covariates Measures

Metropolitan areas can cover a wide geographical area and comprise heterogeneous populations. To account for county-level differences in demographic composition which may be associated with factors that facilitate conditions for transactional sex, we also included in our analysis sex ratio,<sup>50, 51</sup> age distribution,<sup>34, 52, 53</sup> predominant racial/ethnic group,<sup>34, 53</sup> percent foreign born<sup>16, 17</sup> and poverty.<sup>54</sup> It should be noted that factors that predict population growth mainly encompasses trends in economic activity and consumer preferences, and do not include a strong representation of socio-demographic characteristics.<sup>6, 55</sup> However, population growth may be associated with location within the metropolitan area (i.e. central cities, fringe counties) for some metropolitan areas as some factors linked to sprawl and local economic mix are negatively linked to older central cities, thus negatively associated with central city socio-demographics.<sup>6, 56</sup> Derived from the 1990 Census SF-1 data,<sup>46</sup> corresponding to the baseline for population growth only, we calculated sex ratio for ages 14 to 49 years old and percent of the population in this age range for the three largest racial/ethnic groups in the U.S, and the county's predominant racial/ethnic composition. Predominant racial/ethnic group was classified into five mutually exclusive categories (non-Hispanic white, non-Hispanic Black/African American, Hispanic/Latino of any race, other non-Hispanic,

and multi-ethnic) based on the proportion of the population in each race/ethnic group in the county in reference to the proportion found in the nation. Counties where the proportion of more than one racial/ethnic group was greater than the national average were classified as multi-ethnic. Due to the low frequency of men from counties determined to be predominantly of Hispanic population or other race non-Hispanic, we reassigned them to a multi-ethnic county. Percent foreign born in 1990 and the proportion of the population with a ratio of income in 1989 that was below the poverty level in each county were obtained from the Area Resource File.<sup>57</sup> These measures were transformed to its natural log and square root, respectively, to approximate a symmetric distribution for regression analysis.

### Statistical Analysis

All county-level variables were linked to survey data by Federal Information Processing Standards (FIPS) code. Of the 652 men surveyed in the NSBME, the analytic sample consists of 303 men aged 26 to 45 years old who met all the following criteria: 1) resided in a county that increased population from 1990 to 2000 and was part of a multiple-county MA; 2) reported ever having had sex; and 3) answered the question on ever sex with a sex worker. This study excluded 144 men aged 18 to 25 years old because of their low prevalence in ever having had paid for sex (<2%). Of the 205 men aged 26 to 45 years old that were excluded, 94 resided in a non-metropolitan county, 39 resided in a single county-MA, 47 resided in a metropolitan county that lost population, 10 reported to have never had sex and 15 did not answer the question on ever sex with a sex worker. Men who reported to have never had sex with anyone were excluded from the analysis to represent sexually active men with and without a history of buying sex. Compared to men included in the analysis, men meeting the selection criteria who were excluded for missing outcome information (N=15) were less likely to have identified their race/ethnicity as non-Hispanic white ( $P<0.05$ ) but did not differ in other demographic characteristics measured.

Men' characteristics by type of population growth were compared using chi-squared tests for categorical variables and Kruskal-Wallis test for continuous variables. A chi-squared test was also used to compare counties' type of population growth and urbanization level, as defined by the 1990 National Center Health Statistics Urban Rural Classification Scheme for Counties.<sup>58</sup> Generalized estimated equations (GEE) were used to calculate unadjusted prevalence ratio (PR), adjusted prevalence ratio (Adj. PR) with corresponding 95% confidence intervals (CI) to examine the association between type of county

growth in relation to the MA and clients. Regression models were adjusted for age and educational attainment to account for possible differential opportunity in their lifespan to have bought sex, as well as a composite of cocaine and injection drug to account for affiliation to drug-using social environment that may heighten opportunity for transactional sex. Furthermore, the association between type of county growth and clients was examined with the inclusion of county-level covariates, previously described. GEE models were specified using log link, Poisson distribution with robust variance estimator and an exchangeable within-group correlation matrix structure to account for observed clustering of participants from the same county. Men were interviewed by a telephone interviewer or by telephone-audio computer self-interviewing system, but there was no association in the reporting of sex with a sex worker and interview mode ( $p=0.66$ ), therefore responses from the two interview mode were combined. All analyses were conducted unweighted using Stata/SE 11.2 for windows.<sup>59</sup>

## Results

Men's demographic characteristics, STI/HIV screening and drug use history are presented in Table 5.2. The median age of men in this sample was 36 years (IQR 30-40). Most were white non-Hispanic (77%) and were currently married or living with a partner (70%). One-in-five (19%) had been tested for HIV in the past year and 7% had a history of bacterial STIs. Roughly one-third (32%) reported binge drinking and 27% had sex while under the influence of alcohol in the past month. In terms of illicit drug use, history of cocaine use was far more common than injection drug use. Except for marital status, no statistically significant differences were observed among men when their characteristics were stratified by the speed of population increases. Table 5.2 also displays a comparison of the 1990 socio-demographic composition for the counties that the men in the sample resided at the time of the survey in 1999-2000. Counties that increased population at a slow speed for their MA were more likely to have had a higher proportion of non-white population ( $p<0.001$ ), foreign born ( $p<0.001$ ) and poverty ( $p<0.001$ ) and a lower sex ratio of men among Blacks/African Americans ( $p<0.001$ ) than counties that increased population at a similar or faster speed relative to their MA. Counties that increased population at a similar or faster speed were less likely to include the county or counties that contain all or part of any central city of metropolitan areas of at least one million people ( $p<0.001$ ; not shown).

The prevalence of clients in metropolitan counties that increased population was 17.5% (Table

5.3). A higher prevalence of clients resided in counties that had had a similar or a faster population increase relative to its MA versus a slow increase, but this difference failed to reach statistical significance. Multivariate models examining population increases with clients adjusting for individual characteristics and county-composition are presented in Table 5.4. In multivariate analysis, clients were significantly associated with history of drug use when adjusting for individual demographic characteristics (Adjusted Prevalence Ratio [Adj. PR]: 2.9; 95% confidence interval [CI]: 1.7-5.1;  $p<0.001$ ), and after including county-level compositional characteristics (Adj. PR: 2.6; 95% CI: 1.5-4.6;  $p<0.01$ ). Clients were roughly two-folds more likely to reside in counties that had a population increase that was similar to its MA or fast for its MA, versus a slow population increase for its MA when adjusting for individual characteristics and county-level composition characteristics (Adj. PR: 2.4; 95% CI: 1.1-5.3;  $p<0.05$ ; and Adj. PR: 2.5; 95% CI: 1.1-5.9;  $p<0.05$ , respectively). The latter multivariate regression model was also examined with the inclusion of a variable for central city status. The results remained relatively unchanged: similar population increase as the MA, Adj. PR: 2.2; 95% CI: 1.0-4.90,  $p<0.05$ ; and a fast population increase for its MA, Adj. PR: 2.4; 95% CI: 1.0-5.8),  $p<0.05$ ). Residing in the central city portion of large MAs was not found to be a statistically significant predictor of buying sex from a sex worker ( $p=0.452$ ). Furthermore, the inclusion of individual's race/ethnicity and marital status in the regression model for the relationship between type of population growth and buying sex, inclusive of other individual and county-level variables, did not help explain the relationship found.

## Discussion

This study is one of the first to empirically examine the relationship between increases in population within metropolitan regions and the prevalence of male clients of sex workers. We found that clients were more likely to reside in counties that were increasing population at a similar speed as its overall region or to reside in counties that were increasing population much faster than the overall region. Correspondingly, clients were less likely to reside in counties in which population increase lagged behind neighboring counties in the region. These results indicate that the relationship between population increase and the prevalence of clients hinges on the regional context of population change. This supports the notion that population increase may be a social determinant of STI/HIV since it can shape differences in the distribution of key high-risk groups within U.S. metropolitan areas.<sup>60-62</sup>

A number of studies in international settings have examined the prevalence of clients of sex workers in relation to urban-rural status. The overall findings of these studies suggest that differences in the prevalence of clients by urbanization level may be country-specific.<sup>28, 29, 63, 64</sup> Limited consideration, however, has been given to the relationship between the non-uniform population increase within an existing urban area (i.e. the process of urbanization) and STI/HIV risks so it is possible to place our findings within the context of an existing literature.

The relationship between urbanization and the increased prevalence of male clients may occur because of changes in individuals' social network membership, and perhaps, by the presence of network members who are more approving of high-risk behaviors or the absence of members who might discourage high-risk sexual relations. Theoretical work by Wellman<sup>65</sup> and Laumann and colleagues,<sup>66</sup> and methodological studies examining personal social networks and HIV risk suggests that the relationship between urbanization and the prevalence of male clients may arise because: (1) urbanites may be weakly involved in multiple social networks; (2) social network members can convey information about and control over available sexual partnerships; and (3) urbanization may lead to an absence of stakeholders in the social network who might discourage high-risk sexual relations in urban spaces.

The separation of work, residence, and kin relationships in urban settings shapes individuals to be involved in multiple social networks in which most members may not be closely linked, and primary ties may be physically remote. This is thought to occur because: (a) there is high mobility in the population; (b) it takes time to develop strong ties in new settings; (c) there is an increased likelihood of forming ties with others who have spatially dispersed primary ties; and (d) there are increased opportunities to access diverse, loosely connected, social networks in the many venues for social interaction in urbanized areas.

Social environments are pathways through which information and control of behavior is conveyed.<sup>66, 67</sup> Larger personal networks may increase the opportunity to meet potential sexual partners of varying HIV risk,<sup>68</sup> and larger and less dense personal networks may influence exchange relationships.<sup>69</sup> Less dense personal networks may include weakly connected members who are less concerned about discouraging other members from having high risk partners. In contrast, strongly connected social network members, such as parents or close friends, may exercise control over sexual partnerships by acting as stakeholders, discouraging some types of sexual behavior and partners.<sup>41, 66</sup>

Sexual behavior is spatially bounded by the costs and time required for commuting to settings where one could meet different types of sexual partners (i.e. exchange, long term, casual) and maintaining an ongoing sexual relationship.<sup>66</sup> The venues for meeting sexual partners have sexual cultures that provide criteria for organizing sexual partnering (e.g., visual cues of the sexual orientation, information about the prospect and acceptability of meeting a casual sex partner, beliefs about paid partners, etc.). Locales experiencing rapid population growth may have a greater proportion of residents who lack locally-bounded primary ties that might allow them to act as stakeholders within the local context where sexual partnering occurs. Mahay and Laumann,<sup>70</sup> for example, have reported that heterosexual men living in an area where there were few long-term residents or relatives living in the same city were less likely to share mutual friends with their last sex partner or have a relative who knew their last sex partner compared to men living in an area with more population permanency and a strong family presence in the same area. In urban gay settings, length of residency among migrant men who have sex with men has also been associated with embracing a local subculture of high-risk behavior and more drug-using friends, thereby increasing the likelihood of HIV transmission.<sup>71</sup> Further research is needed, however, to directly examine the relationship of social networks operating in areas experiencing rapid population growth and men's sexual risk taking.

In the present study, the relationship between thriving population growth within a local region and the proportion of men who have purchased sex was statistically significant when we included the 1990 county-level socio-demographics. In bivariate analyses (not shown), counties classified as multi-ethnic, having a higher proportion of foreign born, and an intermediate sex ratio for Hispanics, in 1990, had a higher proportion of men buying sex. We have shown that social-demographic characteristics were unevenly distributed by type of population growth at the baseline assessment of urbanization. In fact, counties that were classified as being multi-ethnic, they had higher proportion of foreign born, and an unbalanced sex ratio for Hispanics were least likely to have outperformed their regional population growth. These socio-demographics characteristics were more likely to be found in large and older central cities because they have a higher concentration of ethnic and racial minorities and foreign born residents. Older cities tend to have a less robust economic growth and fewer of the consumer-based amenities that have encouraged population growth.<sup>6, 56</sup>



The unadjusted relationship between socio-demographic characteristics and the prevalence of men who buy sex may arise from the ways in which sexual partnering is structured by the place one lives. For example, Mahay and Laumann<sup>70</sup> found that in an area with a high concentration of Hispanics of multiple nationalities, there was strong cohesion within but not between these ethnic groups in sexual partnering, differences in cultural norms protecting female sexuality and varying degree of religiosity. These factors narrowed sexual choices and pushed some men into seeking sex in casual settings outside of their strong family networks. Nevertheless, the present study's findings indicate that with approximately equivalent socio-demographics composition, counties that are growing within their region foster an environment for transactional sex to occur.

This study found that licit and illicit substance use was similar for men residing in metropolitan counties regardless of the speed of population growth. One-third of men in this study, (restricted to metropolitan counties that increase population) reported cocaine use in their lifetime. This is a higher prevalence than estimated for U.S. men aged 26-34 years old (22%) and 35 and older (13%) in a contemporaneous national survey. Our higher prevalence may reflect the higher the prevalence of cocaine use in metropolitan areas versus non-metropolitan areas.<sup>72, 73</sup> A history of injection drug or any form of cocaine use remained independently associated with buying sex from a sex worker in multivariate models. Using our composite variable for harder, we found that among the men who used harder drugs most were cocaine users who did not report injecting drugs. However, we also found that almost all injection drug users also reported cocaine use. Although this study did not measure the form of cocaine used, the concomitant risk behaviors of buying sex and cocaine use in this sample of the general population is consistent with reports linking the crack-cocaine use and the exchange of money or drugs for sex.<sup>54</sup> It also highlights the potential synergism of drug use and buying sex on STI/HIV risks that has also been reported for among women who sell sex.<sup>23, 74, 75</sup> This result suggests that STI/HIV prevention activities targeting the sexual risk behaviors of male drug users may benefit a segment of the clients of sex workers who have been considered a more elusive population.

Two reports based on convenience samples of male clients in Chicago, Illinois, indicate that aside from escort services and private parties, licit businesses such as bars, strip clubs, and lap dance clubs are common venues where sex is illicitly purchased.<sup>76, 77</sup> Hubbard<sup>78</sup> and Brents<sup>79</sup> have suggested that a

consumerism based-economy has contributed to the marketing of adult-entertainment business as another legitimate recreational or leisure activity to direct men's spending. Our results are more likely to indicate that clients reside in the more economically vibrant counties of a metropolitan area. Counties that had the fastest population increases for their metropolitan area were less populated in 1990 but were part of more populated metropolitan areas, and more likely to be in the fringe areas of metropolitan areas with at least one-million people. Counties that increased population at a similar speed as its overall region population were more likely to be part of fringe areas of more populated metropolitan areas or part of metropolitan areas of at least 250,000 to less than one million people. One avenue for future research could be to examine the potential regional geographical spread of infection between popular adult-entertainment venues and clients' residence to assess the need for inter-county public health partnerships in STI/HIV screening, partner notification services and prevention programs.

This study's results should be viewed in light of its limitations. This is a secondary analysis and several measures pertinent to the buying of sex were not collected including: gender of sex worker, locations, frequency of paid sex, and condom use. We also could not examine clients in relation to length of residency in the current county. The study is based on a small sample size, which weakens our power to detect associations in our statistical analyses. Furthermore, results derived from telephone surveys may under represent adults living in poverty, racial/ethnic minorities and those living alone or with roommates because these subpopulations are more likely to reside in households without telephone service.<sup>80</sup> We also note that the examination of counties can mask subtle population shifts occurring within the county, and other unmeasured factors may alter patterns of population change within a metropolitan area and these factors may vary between metropolitan areas. Finally, it should be noted that the prevalence of male clients at the baseline period of population change is not known.

### Conclusion

The foregoing findings indicate that the speed of population growth (within its regional context of population change) may help identify areas that may be more vulnerable to the spread of STI/HIV associated with transactional sex. Male clients represent an important high-risk group as they tend to engage in behaviors that put them at higher risk of acquiring and spreading STI/HIV. A larger study

would be needed to help identify variations in clients STI/HIV risks across racial/ethnic and social-economic groups within settings experiencing population increases.

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**Table 5.1. Median and interquartile range of population size and change by county population growth relative to its metropolitan area, U.S. 1990 to 2000.**

	County grew at a slower rate than its MA	County grew at a similar rate than its MA	County grew at a faster rate than its MA
Number of U.S. Counties	197	218	241
County Population Size in 1990	125,486 (47,225-426,060)	101,514 (51,781-217,069)	61,816 (31,269-137,157)
County Population Change, 1990 to 2000, %	7.63% (4.47 to 15.07)	12.50% (6.47-19.02)	29.69% (19.25-43.22)
Metropolitan Area Population Size in 1990	882,060 (368,681-2,447,491)	838,365 (305,845-2,485,439)	1,352,376 (500,487-2,911,837)
Metropolitan Area Population Change, 1990 to 2000, %	13.37% (9.24 to 21.20)	10.64% (5.17-16.43)	13.37% (8.73-18.89)
Number of Counties in Metropolitan Area	6 (3 to 11)	5 (3-10)	7 (4-13)

Note: restricted to counties part of multiple-county metropolitan areas.

**Table 5.2. Individual characteristics of men in metropolitan counties that increased population and the 1990 socio-demographic composition of men' county of residence in 2000.**

(Sample size)	Total (N=303)	County grew at a slower rate than its MA (N=131)	County grew at a similar rate than its MA (N=90)	County grew at a faster rate than its MA (N=82)	Significance
<i>Individual Characteristics</i>					
<u>Demographic Characteristics</u>					
Median age (IQR)	36 (30-40)	36 (30-41)	35 (30-40)	35 (31-38)	0.219
Race/Ethnicity - Non-Hispanic White	77.2%	74.6%	80.0%	78.1%	0.629
Current Marital Status					
Married/Cohabiting	70.2%	63.1%	68.9%	82.9%	0.033
Previously married	10.6%	13.9%	8.9%	7.3%	
Never married	19.2%	23.1%	22.2%	9.8%	
Education Completed					
High School or less	25.4%	22.1%	28.9%	26.8%	0.444
Some college or trade school	30.7%	28.2%	30.0%	35.4%	
Bachelor or graduate degree	43.9%	49.6%	41.1%	37.8%	
<u>STI/HIV Screening</u>					
Ever gonorrhea or chlamydia	7.3%	9.9%	3.3%	7.3%	0.179
HIV test in the past year	19.2%	17.6%	21.1%	19.8%	0.796
<u>Substance Use</u>					
Sex while inebriated in the past month	27.2%	22.3%	31.1%	30.9%	0.245
Binge drinking in the past month	32.1%	29.8%	28.9%	39.5%	0.248
Marijuana in the past year	14.5%	14.1%	13.6%	16.1%	0.891
Ever use any form of cocaine	31.0%	30.2%	36.0%	26.8%	0.422
Ever injected drugs	3.3%	3.8%	2.2%	3.7%	0.790

Notes: MA, metropolitan area; IQR, interquartile range.

**Table 5.2: Continued.**

(Sample size)	Total (N=303)	County grew at a slower rate than its MA (N=131)	County grew at a similar rate than its MA (N=90)	County grew at a faster rate than its MA (N=82)	Significance
<i>County Composition</i>					
<u>Predominant Race/Ethnic group</u>					
Multi-ethnic	52.5%	67.9%	42.2%	39.0%	<0.001
White Non-Hispanic	36.0%	13.7%	52.2%	53.7%	
Black Non-Hispanic	11.6%	18.3%	5.6%	7.3%	
<u>Black/African American Sex Ratio</u>					
Lower third-tile: 74-90	43.2%	57.3%	33.3%	31.7%	<0.001
Middle third-tile: 90-111	39.6%	37.4%	41.1%	41.5%	
Upper third-tile: 112-633	17.2%	5.3%	25.6%	26.8%	
<u>Hispanic/Latino Sex Ratio</u>					
Lower third-tile: 84-102	26.4%	19.9%	26.7%	36.6%	0.005
Middle third-tile: 102-118	44.2%	49.6%	51.1%	28.1%	
Upper third-tile: 118-188	29.4%	30.5%	22.2%	35.4%	
<u>White Sex Ratio</u>					
Lower third-tile: 91-99	30.4%	25.2%	43.3%	24.4%	0.019
Middle third-tile: 99-101	24.4%	22.9%	22.2%	29.3%	
Upper third-tile: 101-120	45.2%	51.9%	34.4%	46.3%	
Median Percent of Whites ages 14 to 49 (IQR)	55.6 (53.1-57.8)	55.6 (53.1-58.6)	54.5 (52.7-55.8)	55.9 (54.2-57.8)	0.002
Median Percent of Blacks ages 14 to 49 (IQR)	57.1 (54.6-60.5)	56.9 (54.6-58.2)	57.5 (55.5-62.0)	58.1 (53.6-62.8)	0.004
Median Percent of Hispanics ages 14 to 49 (IQR)	60.0 (57.1-62.3)	60.4 (57.5-62.3)	59.2 (56.0-61.1)	59.9 (57.5-62.7)	0.027
Median Percent Foreign Born (IQR)	5.3 (2.2-14.0)	8.4 (3.4-14.3)	4.9 (2.1-9.5)	3.9 (1.4-7.0)	<0.001
Median Percent Below Poverty Ratio (IQR)	11.0 (7.2-14.8)	14.3 (12.1-16.0)	9.9 (7.1-11.9)	8.2 (5.5-10.9 )	<0.001

Notes: MA, metropolitan area; IQR, interquartile range; <sup>a</sup> Sex ratio values for sample in analysis.

**Table 5.3. Prevalence of male clients by county population growth relative to the population change in the metropolitan area.**

	N	%	Significance
Total	303	17.49	0.258
County grew at a slower rate than its MA	131	13.74	
County grew at a similar rate than its MA	90	22.22	
County grew at a faster rate than its MA	82	18.29	

**Table 5.4. Association of county population growth relative to the population change in the metropolitan area and male clients.**

	Unadjusted PR [95% CI]	Adjusted for individual characteristics PR [95% CI]	Adjusted for individual characteristics & county composition PR [95% CI]
<i>Type of Population Change</i>			
County grew at a slower rate than its MA	1.0	1.0	1.0
County grew at a similar rate than its MA	1.69 [0.86-3.29]	1.56 [0.82-2.96]	2.33 [1.09-5.01] *
County grew at a faster rate than its MA	1.40 [0.69-2.86]	1.36 [0.68-2.72]	2.50 [1.06-5.86] *
<i>Individual Characteristics</i>			
Age in years		1.04 [0.99-1.09]	1.05 [0.99-1.11] ^
Bachelor or graduate degree (versus less)		0.69 [0.38-1.24]	0.62 [0.33-1.17]
Ever cocaine/injection drug use		2.92 [1.68-5.06] ***	2.60 [1.47-4.60] **
<i>County Composition</i>			
Black/African American Sex Ratio <sup>a</sup>			
Upper third-tile: 112 to 633 (versus lower)			1.60 [0.68-3.78]
Hispanic/Latino Sex Ratio <sup>a</sup>			
Lower third-tile: 84-102			1.00
Middle third-tile: 102-118			1.91 [0.86-4.25]
Upper third-tile: 118-188			1.13 [0.42-3.02]
White Sex Ratio <sup>a</sup>			
Lower third-tile: 91-99			1.00
Middle third-tile: 99-101			0.77 [0.33-1.83]
Upper third-tile: 101-120			0.97 [0.46-2.02]
Percent of Whites ages 14 to 49			1.03 [0.93-1.14]
Percent of Blacks ages 14 to 49			0.96 [0.86-1.06]
Percent of Hispanics ages 14 to 49 (natural log)			0.09 [0.00-189]
County's Predominant Racial/Ethnic Group			
Multi-ethnic or Hispanic			1.86 [0.81-4.24]
Non-Hispanic Black/African American			2.11 [0.59--7.47]
Non-Hispanic White			1.00
Percent Foreign Born (natural log)			1.32 [0.91--1.93]
Percent Below Poverty Ratio (square root)			1.07 [0.64-1.78]

Notes: PR, prevalence ratio; CI, confidence interval.

<sup>a</sup> Sex ratio values for sample in analysis

Significance level: ^ ≤0.10, \* <0.05, \*\* <0.01, \*\*\* <0.001.

## **Chapter 6**

### **Conclusions and future directions**

## Summary of Results

The overall goal of this study was to examine the relationship between urbanization and men who buy sex from sex workers (henceforth referred to as clients) in the United States. The main objectives were to: 1) draw a basic understanding of clients in the general U.S. population by examining clients' STI and HIV risks behaviors and their distribution by urbanization level (chapter two); 2) examine the association between county-level decennial population relative change with the prevalence of clients (chapter three); and 3) explore the association of county's speed of population growth within the regional pattern of population change and clients (chapter four).

Survey data was derived from the National STD Behavioral Measurement Experiment (NSBME) study, a probability sample of English speaking adults residing in U.S. households with a working landline telephone conducted from September 1999 to April 2000. The NSBME measured a wide range of STI/HIV risk behaviors and screening history, providing the opportunity to compare the prevalence of substance use, sexual behavior, STI and HIV screening history between clients of sex workers and non-clients in the general population of the United States (chapter 2). Additionally, county and state codes corresponding to survey participants' household location allowed survey data to link to government sponsored datasets. Specifically, survey data was linked to the National Center for Health Statistics Urban Rural Classification Scheme for Counties to compare the prevalence of clients by urbanization level (chapter 2). Survey data was also linked to non-institutionalized population counts from the 1990 and 2000 U.S. censuses to examine the prevalence of clients by decennial county population relative changes (chapter 3) in U.S. metropolitan areas, and to examine the prevalence of clients by decennial county population increases in relation to its own metropolitan region (chapter 4). The latter analysis classified counties into their respective metropolitan area according to the 1993 Office of Management and Budget definitions for Consolidated Metropolitan Statistical Areas or Metropolitan Statistical Areas and New England County Metropolitan Areas.

### Demographic characteristics of clients of sex workers among U.S. men

The prevalence of men reporting ever having had sex with a sex worker, male or female, increases with age. Due to the low prevalence (2.3%) of buying sex reported among male respondents 25 years of age and younger, we excluded them from the three main analyses. We found that one in seven U.S. men

aged 26 to 45 years old has paid for sex 14.5% (95% Confidence Interval [CI], 11.5-18.1). Men who had not completed college or had attended trade school had a significantly higher prevalence of being clients than men who had completed college.

*STI/HIV risk factors and screening correlates of clients of sex workers among U.S. men*

In chapter two, we utilized data from 469 men aged 26 to 45 years who reported ever having sex and provided a response to the survey question on buying sex. In this first study to examine clients in relation to behavioral risk factors at a national level, it was hypothesized that men with a history of buying sex will be associated with increased risks to STI and HIV. We found that clients had a statistically significant higher prevalence of other high-risk sexual behaviors including: at least six or more lifetime partners; history of same sex-partners; having had a one-night stand in the past year; and having multiple partners in the past year. Clients also had a higher prevalence of engaging in behaviors that put them at increased risk of STI and HIV infection either through elevated levels of substance use or sexual contexts such as selling sex. Clients were associated with both recent and lifetime high-risk sexual activities, which is informative because this study did not measure when clients bought sex.

Although unprotected sex in the past year was vastly common among both clients and non-clients, and clients had a lower prevalence of unprotected sex, our findings highlight that clients should be of considerable concern in the U.S. as they showed to have a disproportionate burden of STIs. Almost one in five clients had a history of bacterial STIs compared to one-in-twenty of non-clients. Despite clients' high-risk behavioral profile, they were no more likely than non-clients to have been tested for HIV. The association between clients and sexual risk factors, illicit substance use and STI history remained statistically significant after adjusting for demographic characteristics.

We repeated the analysis for U.S. men reporting having had heterosexual sexual partners only in their lifetime (N=424). The prevalence of U.S. men that has had sex with a female sex worker was 13.0% (95% CI, 11.5-18.1), and clients' associations with STI/HIV factors and STI history remained unchanged. In chapter 3, we restricted the analysis to 385 men aged 26 to 45 years who resided in metropolitan counties. Consistent with the national findings, purchasing sex was associated with a history of STIs, partner turnover, and use of harder drugs that included cocaine or injection drug use.



In overall, we showed that male clients represent an important high-risk group and findings indicate that clients merit further public health research to help guide more comprehensive prevention measures to address their elevated risks of STI and HIV associated with transactional sex and other risk factors for infection spread in the population.

*The relationship between urbanization and clients of sex workers*

In order to examine whether the prevalence of clients among U.S. men differs by urbanization level of residence, we specifically compared men residing in central cities of large metropolitan areas (i.e. one million people or more) versus categories for less urbanized areas in the U.S. (Chapter 2). Less urbanized areas referred to suburban or fringe counties of the large metropolitan areas, smaller-sized metropolitan areas, micropolitan areas and remaining non-metropolitan counties without a densely settled population. It was hypothesized that urbanization level is positively associated with the prevalence of clients after controlling for confounders. In contrast to expectation, we found that the prevalence of male clients in central cities of large metropolitan areas did not non-statistically differ to those residing in less urbanized areas. Multivariate analyses that were adjusted for potential confounding factors supported that the level of urbanization did not promote or inhibit differences in the prevalence of male clients. This suggests that this key high-risk group is well entrenched across urbanization level in the U.S.

In the U.S., there has been a steady increase in the proportion of the population residing in metropolitan areas (or urbanization) over the past decades. However, population changes are not uniform between or within metropolitan areas. It was hypothesized that a higher prevalence of male clients will be associated with counties that experienced population decline or marginal change. We found instead a positive association between population change and the prevalence of men who have bought sex from a sex worker. We examined population relative changes (Chapter 3) and population increases (Chapter 4) in existing U.S. metropolitan areas with male clients, and consistently found that the speed of urbanization within existing metropolitan areas was associated with the prevalence of clients of sex workers. Specifically, in chapter three, we examined the relationship between population relative changes in U.S. metropolitan counties with male clients using census data matched with survey data. The term “relative” denotes that the difference in population size between two points in time accounts for the baseline population size when calculating population change. The analytic sample consisted of 385 men aged 26 to

45 years old residing in metropolitan areas. Population relative change was examined, in addition to as a continuous measure, categorically using cut-offs for population change that reflected the national average and urbanization level's average (i.e. size of the metropolitan area). The cut-offs used for categorical relative change variables was inferred to represent a contemporaneous marker for economic opportunities and infrastructure developments while also recognizing that the magnitude of population growth may depend on the existing size of the economic area (the metropolitan area).<sup>1, 2</sup> In all three measures, we found a positive association between population relative change and the prevalence of male clients. The findings indicate that one-in-five men residing in metropolitan counties that had an increase in residents at or above the national overall rate of growth had bought sex, compared to about one-in-ten among men residing in counties with lower levels of population change. The results indicate that the speed of urbanization in counties that are already part of established metropolitan areas in the U.S. impacts the distribution of male clients. In multivariate analysis, adjustment for individual demographic characteristics and history of drug use, factors deemed most relevant for an uneven distribution with history of buying sex, made minimal differences in the relationship between population change and clients. To our knowledge, this is one of the first studies to directly examine the relationship between population change and male clients, two important influences in the transmission of STI/HIV<sup>3</sup>.

In chapter four, we sought to clarify the relationship between county population increases and male clients in metropolitan areas by quantifying the speed of population increase in relation to the population change in its own metropolitan region. This was done because there are regional variations in the absolute rate of population growth across the country. As such, the same population increase in a county may reflect a slow increase for its metropolitan region but a fast increase in another when compared to its own metropolitan region. We calculated whether a county increased population at a slower, similar or faster rate than its metropolitan region using 1990 and 2000 population census counts. The analytic sample consisted of 303 men aged 26 to 45 years old who resided in a county that increased population from 1990 to 2000 and was part of multiple-county metropolitan area. We found that clients were more likely to reside in counties that were increasing population at a similar speed as its overall region or to reside in counties that were increasing population much faster as its overall region. Correspondingly, clients were less likely to reside in counties for which the population increase lagged behind its own neighboring

counties in the region. The overall results supported that population increase may be a social determinant of STI/HIV as it can shape differences in the distribution of key high-risk groups within U.S. metropolitan settings.<sup>3-5</sup>

### **Study Strengths and Limitations**

The prevalence of STI/HIV risk factors and STI history among male clients of sex workers and whether the prevalence of male clients differs by urbanization in the United States are poorly understood. The results presented in this dissertation were derived from a cross sectional probability study of U.S. adults surveyed on a wide-range of STI/HIV behaviors and STI history. Furthermore, we were able to link the survey to external data sources to examine the relationship between contemporaneous urbanization level and population changes that had occurred in the county of residence. To our knowledge, this study represents the first population based analysis examining differences in sexual behavior, substance use, and history of STI/HIV screening, as well as urbanization between adult U.S. men aged 26 to 45 years old with and without a history of buying sex from sex workers. Despite the quality of the sample to examine the influence of an understudied structural factor on STI/HIV risk, the results should be viewed in light of several limitations.

This is a secondary analysis and several measures pertinent to infection risks associated with buying of sex were not collected including gender of the sex worker, how often men paid for sex, type of sexual act purchased, condom frequency for paid sexual acts, and constancy with venue type and with sex workers. Furthermore, this study did not measure the location where clients bought sex in relation to the current residence to inform on the potential geographical spread of STI/HIV and provide guidance on how to better reach the population of male clients for further research. History of migration was also not collected in the survey to examine whether length of residency in the current county was associated with history of buying sex.

Self-reported history of chlamydial and gonorrhea infection were the only STIs measured in the study, thus limiting our understanding of clients' infection risk. These STIs are less common among men aged 26 to 45 years old than in younger ages, and it is possible that men may have not remembered or underreported ever having it. These STIs are also commonly asymptomatic and some men may have been unaware of having been infected to seek medical care.

The NSBME was designed to compare responses to sensitive measures between standard telephone interview and telephone-ACASI. While the reporting of buying sex was not associated with interview mode, differences by interview mode were observed for two of the fourteen behavioral and STI/HIV screening characteristics examined among men aged 26 to 45 years old. These corresponded to marijuana use in the past year and HIV testing in the past year. Further examination showed that the increased reporting of these two factors derived from telephone-ACASI did not differ between men with and without a history of buying sex, and the reported estimated associations in chapter two are trivially attenuated as these do not adjust for interview mode.

Sampling weights were applied to deliver national estimates. Sampling weights reflect the varying probabilities of selection, non-response and post-stratification adjustments to match Census estimates of key demographic groups. However, telephone surveys may under represent responses from men living alone or with roommates, in poverty, and ethnic/racial minorities as persons with these characteristics were less likely to live in households with telephone service.<sup>6</sup> A comparison of demographic characteristics and urbanization level of residence derived using an unweighted and a weighted analysis suggest that the study had a slight under coverage of Blacks/African Americans but a similar coverage by urbanization level.

The study is based on a small sample size which jeopardizes the power to detect associations in our analyses. The small sample limited the ability to examine STI/HIV risk factors for clients between urbanization, and to examine the relation between population changes and clients in micropolitan and residual non-metropolitan counties. This was a cross-sectional analyses and the temporal sequence of purchasing sex in relation to other behavioral risks, history of STIs and current residence was not documented. Furthermore, the prevalence of male clients at the baseline period of population change is not known to elucidate on potential spatial changes in the prevalence of clients and ratify a relationship between population changes and clients. Lastly, the national population growth in the 1990s was higher than the population growth observed between decennial censuses since the 1970s or the 2000 to 2010 decade, likely due to shifts in the job and housing market which may have influenced the volume of migration.<sup>7,8</sup> Future studies may need to examine whether the relationship between population changes and clients is consistent during other periods of lower population growth.

## **Public Health Significance**

A wide range of STIs are associated with an increased risk to a wide range of morbidities, and substantial economic burden. Derived from biological specimens collected in national surveys and census population estimates, it was estimated that in 2008 there were an estimated 110 million prevalent STIs among men and women in the United States, resulting from chlamydia, gonorrhea, syphilis, trichomoniasis, herpes, human papillomavirus, hepatitis B, and HIV.<sup>9</sup> Medical complications from these behaviorally driven infections may include infertility, pregnancy and childbirth adverse outcomes, cancers, susceptibility to other infections, neurological conditions and organ impairments. Newly diagnosed STIs and HIV in the U.S. are thought to total an estimated \$16 billion in direct medical lifetime costs.<sup>10</sup> Although combined STIs' expenditures that exclude HIV account for roughly only one-fifth of these costs,<sup>10</sup> HIV acquisition and transmission may be enhanced by the presence of STIs.<sup>11, 12</sup> In the U.S., HIV disease rank within the top six leading causes of deaths among adults aged 25 to 44 years old, and is the leading infectious disease within the top ten causes of deaths in the ages of 15 to 54 years old.<sup>13</sup> These age ranges correspond to prime reproductive age years and economically productive years, thus stressing the scope of STIs and HIV disease to impact the lives of individuals and social structure.

Limited research attention has been given to clients of sex workers' increased risk of infection and their potential role in the spread of infection to their sexual partners. In this dissertation, we identified the need to take a more vigilant look at men who buy sex from sex workers to help guide more comprehensive STI/HIV prevention measures from multiple-levels to reduce the health and economic burden of these infection in the U.S. We have observed that male clients should be of considerable concern in the U.S. as they showed a disproportionate burden of STIs. Clients had a higher prevalence of engaging in behaviors that put them at increased risk of acquiring and transmitting STI and HIV such as partner change and substance use. Despite clients' high-risk profile, they were not more likely than non-clients to have been tested for HIV in the past year. Thus, this work points out that male clients may be a specific vulnerable subgroup missing out from the national HIV strategy that aims to reduce the spread of infection by increasing awareness of HIV status and improve health outcomes for those infected through timely treatment.<sup>14</sup> While clients of sex workers have been considered to be a more elusive population at large to target for STI/HIV interventions, we observed that population change, and in particular counties

experiencing an above average population increase, may be a resourceful geographical indicator for developing interventions that aim to reduce STI/HIV risks from transactional sex.

### **Future Research Needs**

Existing research suggests that urbanization favors the more socioeconomically stable geographic areas.<sup>15, 16</sup> The overall findings support an elevated prevalence of clients in areas experiencing above average urbanization. Future research needs to examine differences in the social environment, perhaps including differences in the work environment, of working aged men that may help elucidate the relationship between faster growing counties and clients. Geographical variation in the disclosure of HIV status on online dating websites has been reported<sup>17</sup> which suggest that social norms about perceived infection risk may be locally fixated, and raises concern on whether paid sex in economically prospering environments may be more likely construed as normative and of inconsequential sexual risk.

Individuals in high-poverty areas have a higher risk of STI/HIV infection.<sup>18-21</sup> Areas with high poverty levels are less likely to increase population. We found that clients were similarly as likely to reside in counties that lost population as in counties of slow population growth versus faster growth. While clients' high behavioral risk profile may facilitate infection spread to potential low-risk sexual partners, a better understanding is needed of the extent of the role that clients play in the regional geographical spread of infection from high-infection areas to low-infection areas. Some have theorized that high-risk individuals' affiliation to members in high-infection risk geographical areas in metropolitan areas may be more likely responsible for continuously maintaining infection levels in less densely populated areas<sup>22</sup> and between economically disadvantaged neighborhoods within metropolitan areas.<sup>23</sup> Understanding the geographical spread of infection may inform on the need for public health inter-county partnerships in STI/HIV screening, partner notification services and prevention programs.

The national HIV/AIDS strategy endorses intensifying HIV prevention efforts in communities where HIV is more concentrated, expand targeted efforts, and educate all Americans about preventing HIV.<sup>14</sup> Additional studies are needed to identify variations in clients STI/HIV risks between racial/ethnic groups and within MSM, in settings experiencing population increase, and in the context of the background level of infection to educate the public and mobilize community partnerships as needed. Increasing access and linking new diagnosed cases to HIV-related care are one of the key steps to reducing pre-mature

mortality in adults living with HIV.<sup>14</sup> Counties that had the fastest population increases for its metropolitan area were less populated at the baseline period than counties with slower population increases. These corresponded to the outer fringe counties of the more populated metropolitan areas and smaller sized-metropolitan regions. An appropriate geographical contextual factor to examine the relation between population changes and clients is by the availability of providers and clinical services for infectious diseases, in particular for STI/HIV care, to inform on the feasibility public health efforts to improve health outcomes among people with living HIV.

## **Conclusions**

This dissertation examined STI/HIV behavioral risks and screening history correlates for clients of sex workers, and explored the relationship between urbanization and men who buy sex from sex workers in the general U.S. population. We contributed to the body of knowledge by showing that U.S. male clients represent an important high-risk group for STI/HIV, and that is not urbanization level, but the speed of urbanization in counties that are already part of established metropolitan areas in the U.S. that influences their distribution. To our knowledge, this is one of the first studies to directly examine the relationship between population change and male clients, two important influences in the transmission of STI/HIV. Clients merit further public health research to help guide more comprehensive prevention measures to address their elevated risks to STI/HIV and role in the current HIV epidemic. In addition, further research is needed to identify variations in clients STI/HIV risks between racial/ethnic groups, MSM and social-economic characteristics within settings experiencing population increases and in the context of the background level of infection, to educate the public and mobilize community partnerships as needed.

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**MARIA A. VILLARROEL**

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**EDUCATION**

- 2013                      **The Johns Hopkins Bloomberg School of Public Health (JHSPH)**  
Baltimore, Maryland
- Doctor of Philosophy Candidate, Department of Epidemiology  
G.P.A 3.4/4.0  
Dissertation: "Urbanization and male clients of sex workers in the United States"
- 2001                      **Queens College of the City University of New York**  
Queens, NY
- Master of Arts in Applied Social Research, Department of Sociology  
G.P.A 3.9/4.0
- 1997                      **Queens College, City University of New York**  
Queens, NY
- Bachelor of Arts in Psychology and Sociology  
G.P.A 3.2/4.0

**PROFESSIONAL EXPERIENCE**

- 2010-2012              **The Johns Hopkins Bloomberg School of Public Health**  
Baltimore, MD
- Teaching Assistant – Principles of Epidemiology (5 credit course)  
(Part-time)
- Teaching in laboratory sessions designed to provide experience in epidemiologic methods and inferences. Prepared exam questions and worked with course faculty and coordinator to finalize exam. Held student office hours. Graded homework and exams, engaged in proctoring exams.
- Graduate Summer Institute of Epidemiology and Biostatistics 2011  
Summer Session 2010 and 2012  
Fall Session, 2010

2010 – 2011	<p><b>The Lighthouse at the Johns Hopkins Bloomberg School of Public Health</b> Baltimore, MD</p> <p>Research Analyst (Part-time)</p> <p>Conduct data analysis to examine the attitudes and norms with sexual risk behaviors of women while a main partner is incarcerated, and collaborate in the preparation of findings for a peer-reviewed journal.</p>
2010	<p><b>The Johns Hopkins Bloomberg School of Public Health</b> Baltimore, MD</p> <p>Interviewer for Household Survey (Part-time)</p> <p>Conduct household enumeration, eligibility screening and facilitate ACASI interview for adolescents and young adults in Baltimore City.</p>
2008-2011	<p><b>The Johns Hopkins Bloomberg School of Public Health</b> Baltimore, MD</p> <p>Survey Interviewer and Pre-test HIV Counselor (Part-time)</p> <p>Conduct in-person interviews on HIV behavioral risk factors and access to HIV prevention among populations at high risk of HIV in Baltimore for the Behavioral Surveillance Research Study (BESURE), part of the yearly National HIV Behavioral Surveillance. Provide pre-test HIV counseling. Men who have sex with men: 2008 and 2011 cycles Injection drug users: 2009 cycle</p>
2009	<p><b>RTI International</b> Washington, DC</p> <p>Research Consultant (Part-time)</p> <p>Conduct in-person interviews on the use of a computer-based interactive counseling for preventing sexually transmitted infections among STD clinic patients in Baltimore City, MD.</p> <p>Data management and prepare documentation for the public data release of the Gonorrhea and Chlamydia Transmissibility Infections Study.</p>

2001-2007

**RTI International**  
Washington, DC

Social Sciences Analyst (Full-time)

Manage project operations, conduct statistical data analysis and assist in all aspects of study implementation and dissemination of findings for various NIH-R01 funded studies measuring sexually transmitted infections and other health-related behaviors in U.S. settings:

- *Monitoring STIs in the Population of Baltimore City*— Study that administered telephone-ACASI surveys and nucleic acid amplification tests of mailed-in urine specimens to monitor the prevalence of *N. gonorrhoeae*, *C. trachomatis*, and *T. vaginalis* among 15- to 35-year-olds.
- *Transmissibility of Gonococcal and Chlamydial Infections* - Study that compares transmissibility and clinical consequences of gonococcal and chlamydia infections detected using nucleic acid amplification tests to infections detected using traditional assays in general clinic setting.
- *Assessment Mode and Validity of Self-reports in Adults and Children*- Study that assesses the validity of three interview modes of self-reported medication adherence for asthma when an objective measure of the behavior is available.
- *National STD and Behavior Measurement Experiment (NSBME)* - Randomized study evaluating telephone-ACASI for measures of sexual behavior versus standard interviewing in a probability sample of U.S. adults.
- *Measuring HIV Risk in a Clinic Setting* –Study that examines whether audio-CASI influenced responses regarding HIV risk behaviors, relative to responses obtained from interviewer administered questioning among young adults attending an urban STD clinic.

2000

**Metis Associates Inc.**  
New York, NY.

Research Assistant (Full-time)

Provide qualitative and quantitative support to the senior research associates in the evaluation of New York City public schools educational summers programs.

1998-2000

**Bronx Community College, City University of New York, Office of Institutional Research and Planning**  
Bronx, NY.

Research Analyst (Part-time)

Assist the Dean of Institutional Research and Planning with data collection, analysis and reporting of students' academic outcomes.

1996 -1997

**Queens College, City University of New York, Search for Education, Elevation, and Knowledge (SEEK) Program**  
Queens, NY.

Tutor (Part-time)

One one-one tutorial sessions for Spanish as a second language coursework.

#### **AWARDS & FELLOWSHIPS**

- JHSPH, Population, Family and Reproductive Health, STI Training Grant, 2009-2011
- JHSPH, School's Diversity and Health Disparities Pre-Doctoral Fellowship Program, 2007-2009
- RTI International, Annual Award for Scientific Stature, Statistics & Epidemiology Division, 2005
- Queens College, City University of NY, Department of Sociology Erich Rosenthal Memorial Graduate Scholarship, 2001

#### **SPECIAL SKILLS**

- Computer Skills: SPSS, STATA, SAS and Microsoft Office
- Languages: Fluent in English and Spanish (native speaker)

#### **PEER-REVIEWED JOURNAL ARTICLES**

- Rogers, S.M., Turner, C.F., Hobbs, M., Miller, W.C., Tan, S., Roman, A.M., Eggleston, E., **Villarroel, M.A.**, Ganapathi, L., Chromy, J.R., Erbelding E. 2003, "Epidemiology of Undiagnosed Trichomoniasis in a Probability Sample of Urban Young Adults", submitted to peer-reviewed journal.
- Davey-Rothwell, M.A., **Villarroel, M.A.**, Grieb, S.D. & Latkin, C.A. 2012, "Norms, Attitudes, and Sex Behaviors among Women with Incarcerated Main Partners", *Journal of Urban Health: bulletin of the New York Academy of Medicine* (published ahead of print).
- Eggleston, E., Rogers, S.M., Turner, C.F., Miller, W.C., Roman, A.M., Hobbs, M.M., Erbelding, E., Tan, S., **Villarroel, M.A.** & Ganapathi, L. 2011, "Chlamydia trachomatis infection among 15- to 35-year-olds in Baltimore, MD", *Sexually transmitted diseases*, vol. 38, no. 8, pp. 743-749.
- Villarroel, M.A.**, Turner, C.F., Rogers, S.M., Roman, A.M., Cooley, P.C., Steinberg, A.B., Eggleston, E. & Chromy, J.R. 2008, "T-ACASI reduces bias in STD measurements: the National STD and Behavior Measurement Experiment", *Sexually transmitted diseases*, vol. 35, no. 5, pp. 499-506.
- Rogers, S.M., Miller, W.C., Turner, C.F., Ellen, J., Zenilman, J., Rothman, R., **Villarroel, M.A.**, Al-Tayyib, A., Leone, P., Gaydos, C., Ganapathi, L., Hobbs, M. & Kanouse D. 2008, "Concordance of Chlamydia trachomatis Infections within Sexual Partnerships", *Sexually transmitted infections*, vol. 84, no. 1, pp.23-28.
- Villarroel, M.A.**, Turner, C.F., Eggleston, E., Al-Tayyib, A., Rogers, S.M., Roman, A.M., Cooley, P.C. & Gordek, H. 2006, "Same-Gender Sex in the United States Impact of T-ACASI on Prevalence Estimates", *Public opinion quarterly*, vol. 70, no. 2, pp. 166-196.
- Turner, C.F., **Villarroel, M.A.**, Chromy, J.R., Eggleston, E. & Rogers, S.M. 2005, "Same-Gender Sex among U.S. Adults: Trends across the Twentieth Century and During the 1990s", *Public Opinion Quarterly*, vol. 69, no. 3, pp. 439-462.

- Rogers, S.M., Willis, G., Al-Tayyib, A., **Villarroel, M.A.**, Turner, C.F., Ganapathi, L., Zenilman, J., & Jadack, R. 2005, "Audio Computer-Assisted Interviewing to Measure HIV Risk Behaviors in a Clinic Population", *Sexually Transmitted Infections*, vol. 81, no. 6, pp. 501-507.
- Eggleston, E., Turner, C.F., Rogers, S.M., Roman, A., Miller, W.C., **Villarroel, M.A.**, & Ganapathi, L. 2005, "Monitoring STI Prevalence Using Telephone Surveys and Mailed Urine Specimens: A Pilot Test", *Sexually Transmitted Infections*, vol. 81, no. 3, pp. 236-238.
- Turner, C.F., **Villarroel, M.A.**, Rogers, S.M., Eggleston, E., Ganapathi, L., Roman, A.M., & Al-Tayyib, A. 2005, "Reducing Bias in Telephone Survey Estimates of the Prevalence of Drug Use: A Randomized Trial of Telephone Audio-CASI", *Addiction*, vol. 100, no. 10, pp. 1432-1444.
- Al-Tayyib, A.A., Rogers, S.M., Gribble, J.N., **Villarroel, M.A.**, & Turner, C.F. 2002, "Effect of Low Medical Literacy on Health Survey Measurements", *American Journal of Public Health*, vol. 92, no. 2, pp. 294-297.

## PRESENTATIONS

- Villarroel, M.A.** "Population Growth within Regional Pattern of Population Change and Male Clients of Sex Workers in U.S. Metropolitan Areas", Poster presentation at the 20th Meeting of the International Society for Sexually Transmitted Diseases Research (ISSTD), and the 14th World Congress of the International Union against Sexually Transmitted Infections (IUSTI) in Vienna, Austria, July 14-17, 2013.
- Villarroel, M.A.** "Population change and male clients of sex work in U.S. metropolitan areas", Poster presentation at the 20th Meeting of the International Society for Sexually Transmitted Diseases Research (ISSTD), and the 14th World Congress of the International Union against Sexually Transmitted Infections (IUSTI) in Vienna, Austria, July 14-17, 2013.
- Villarroel, M.A.** "Male clients of sex workers in the United States: Correlates with STI/HIV Risk Behaviors and Urbanization level", Poster presentation at the 20th Meeting of the International Society for Sexually Transmitted Diseases Research (ISSTD), and the 14th World Congress of the International Union against Sexually Transmitted Infections (IUSTI) in Vienna, Austria, July 14-17, 2013.
- Villarroel, M.A.** "Population Growth within Regional Pattern of Population Change and Male Clients of Sex Workers in U.S. Metropolitan Areas", Poster presentation at the Population Association of America Meeting in New Orleans, LA, April 11-13, 2013.
- Villarroel, M.A.** "Clients of sex workers by urbanization level in the United States", Poster presentation at the American Public Health Association 140th Annual Meeting and Exposition, San Francisco, CA, October 27-31, 2012.
- Villarroel, M.A.**, Rogers, S.M., and Turner, C.F. STI-related risk behaviors and STI disparity between residents of Baltimore City and other urban cities in the U.S. Poster presentation at the International Society for Sexually Transmitted Diseases Research 19th Meeting, Québec City, Canada, July, 10-13, 2011.
- Villarroel, M.A.**, Rogers, S.M., & Miller, W.C. "NAAT identified chlamydial infections: Enhanced sensitivity, reduced transmissibility?" Oral Presentation at the American Association of Public Health 135<sup>th</sup> Annual Meeting and Exposition, Washington, DC, November 3-7, 2007.
- Villarroel, M.A.**, Rogers, S.M., & Miller, W.C. "Risk Factors Associated with Recurrent Infections Among Young Adults" Oral Presentation at the American Association of Public Health 134<sup>th</sup> Annual Meeting and Exposition, Boston, MA, November 4 to 8, 2006.

**Villarroel, M.A.**, Turner, C.F., Rogers, S.M., Eggleston, E. "Using T-ACASI to Improve the Accuracy of Sexually Transmitted Disease Measurements." Oral Presentation at the Population Association of America Annual Meeting, Philadelphia, PA, March 31-April 2, 2005.

**Villarroel, M.A.**, Turner, C.F., Eggleston, E., Al-Tayyib, A., Rogers, S.M., Roman, A.M., Cooley, P.C., and Gordek, H. "Same-gender Sexual Contact in the USA: Impact of New Telephone Survey Technology on Prevalence Estimates." Oral presentation at the American Association of Public Health 130<sup>th</sup> Annual Meeting and Exposition, Philadelphia, PA, November 9-13, 2002.

#### **PROFESSIONAL ASSOCIATIONS**

- American Public Health Association
- Population Association of America
- International Society for STD Research